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IN TWO SECTIONS
Section 1

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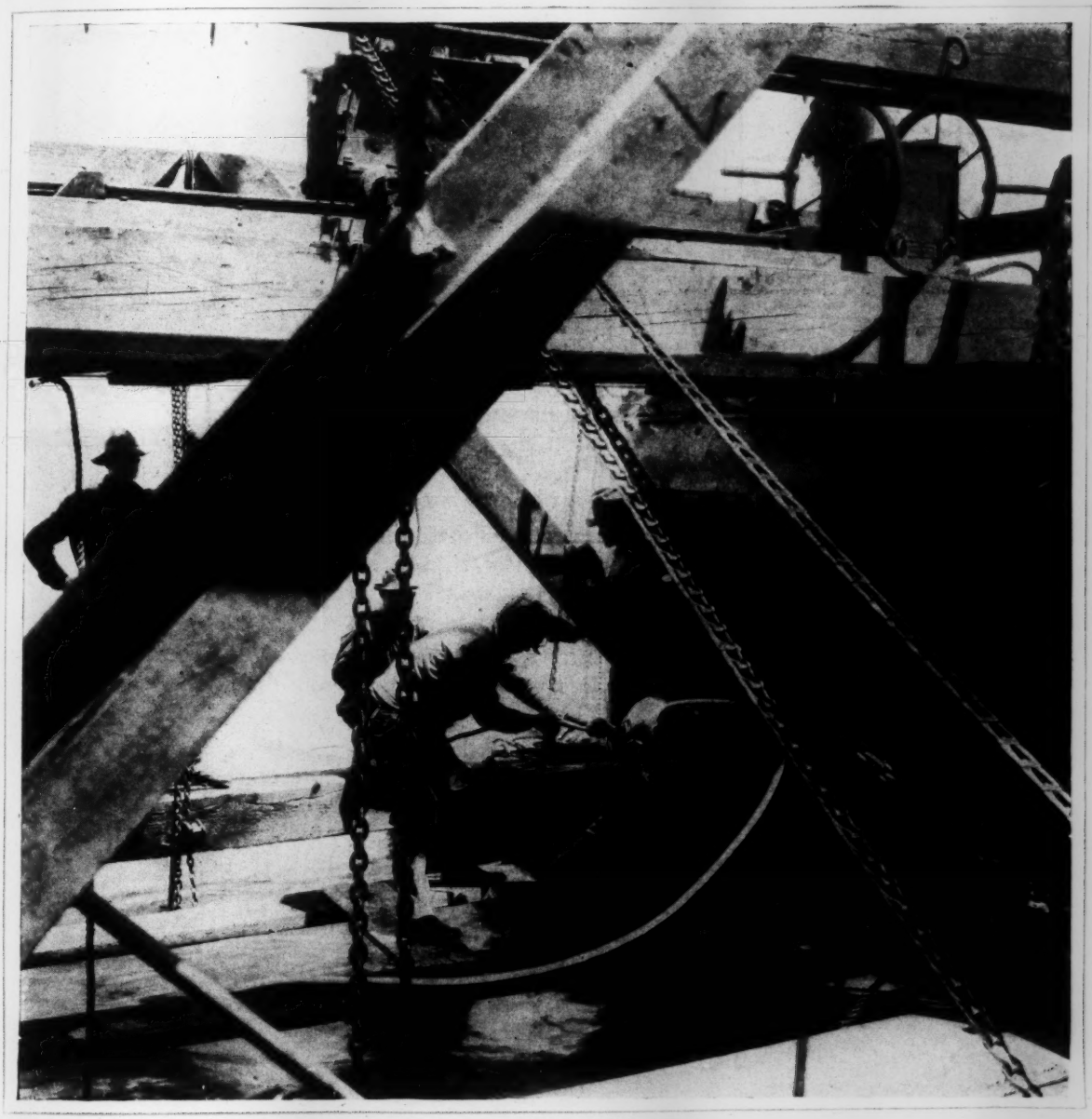

Diver Working from Pipe-Laying Barge
Marston Lake Intake, Denver

Laying Intake Through Earth Dike Under Service—Crossing Elimination and Road Relocation in California—Staff Report on the Annual Convention of the American Association of Engineers—Agricultural Engineering Progress and Opportunities—Concrete Bridge Designed for Elastic Movement

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FRANK C. WIGHT
Editor

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A Concrete Bridge Novelty

REFINEMENTS of design far beyond anything ever attempted in this country are revealed in the Swedish reinforced-concrete bridge described on p. 1022 of this issue. These lie particularly in the use of hinges, the provision for elastic movement and the dependence upon interwoven hooping to add strength at critical points. All of these details, however, have been tried out by American engineers, though few of them have been convinced that such details give results adequate to pay for the labor and cost involved and many, besides, doubt the practical consummation of the theoretical gain. It is in the excessive variation of the proportions of the mix, however, that this structure is distinctly strange to Americans. A small variation between foundation and superstructure concrete is common here and an occasional bridge will be found with a weak lean mix for filling concrete, but to vary proportions at every place that the stress sheet shows a different demand for strength or elasticity is carrying dependence on the knowledge of concrete behavior pretty far. The usual explanation of the difference between European and American practice in structures has been that over there labor is cheaper, materials more expensive and machinery rarer than here, but with changing times Europe must be approaching America in the relative costs of these items. The more plausible explanation of such differences as the Swedish bridge shows is that European engineers are more inclined to bend practice to theory than the American, who might be said to use theory mainly to justify practice.

How Precedent Is Built Up

PATENT validity, particularly where structural patents are concerned, is built up largely on the precedent of acceptance by earlier so-called infringers. The technique of the patentee has been fairly well established. First, of course, he has to get a patent and then to have it upheld in the lower courts. This is fairly simple, for up till quite recently at least the Patent Office has been unable to distinguish between invention and design in a static structure, and lawyers both on and off the bench have been equally dense. Armed by the law, then, the patentee seeks first a few amenable infringers, who to avoid difficulty and to save money, admit infringement and pay nominal damages. The patent thus becomes well established, the record of admitted infringement impressive and the chance remote of there arising an accused infringer bold enough to start anew the fight against the grant of a government monopoly to what, to all engineers familiar with the processes of design, is merely the exercise of normal engineering thought. The system by which such patents are promoted is pernicious but difficult to combat, because the individual as a rule finds it cheaper and easier to surrender than to fight. A peculiarly flagrant case has just come to hand. A public commission, against the advice of its engineers, has just paid over a large royalty, because the individual members of the board had been led to believe by certain legal decisions that they were personally responsible for any damages awarded a contesting patentee after a successful infringement suit. The patentee now has this successful claim to wave before any other public body it chooses to intimidate and will continue to have it until some one has courage enough to fight, and perhaps luck enough, patent courts being what they are, to win a suit based not on superficial legalities but on the obvious engineering fundamentals involved in this particular patent.

Small City Paving

STREET resurfacing is a problem that all cities have to face. Increasing traffic, both as to amount and as to weight, is playing havoc everywhere. But the burden of replacement is falling more heavily upon the town or small city than it is upon the good sized city where a fair percentage of so-called permanent pavement had already been placed before the motor became so omnipresent. Asphalt, concrete and brick pavements give way to some degree under the continual wear of the rubber tire, as million dollar annual budgets for street work in such cities as Cleveland and Pittsburgh testify, but such pavements are marvels of permanence compared to the old waterbound or even oilbound macadam which made up the majority of the street surfaces of the minor city ten years ago. These second-class roads are going to pieces fast and their replacement means just that, not merely repair. In consequence many a town of 10,000 is faced today with the necessity of spending a million or more in street construction, if it would modernize its street system. This means bond issues added to already overburdened indebtedness, or the alternative of piecemeal surface repair out of current funds with the continual prospect of the evil day approaching when the repair system will not suffice. City fathers in such places need the courage to foresee the inevitable and to plan a systematic reconstruction, within the permissible financial capacity of the town, so that in some given time they will have permanent streets to replace the simple roads which sufficed for the village or town in the days of the horse-drawn vehicle. Trying to make those old roads over into modern streets merely by a surface treatment is as hopeless as trying to brush back the rising tide.

City Planning By Convention

NEW YORK CITY is going to try to plan for its future growth by convention rather than by experts or by officials. The mayor has appointed a committeee of nearly five hundred men and women who are to report on what the city must do, physically, to keep pace with its growing needs. Among those who will deliberate are numbered the gentleman who directs the destinies of the city's most authoritative political organization, a boxing commissioner, some theatrical impresarios, and a miscellaneous collection of "business

men." But there are, too, more than a sprinkling of competent engineers, architects and housing experts, who will furnish a leaven of real knowledge. The main work is to be done in committees and doubtless there will be a sufficiency of expertness on each of these to make their conclusions of real merit. The whole scheme has considerable appeal, especially for a large city, because by wise selection a cross-section of the city's directing thought is bound to be enlisted in favor of what the committee eventually reports. City planning does not require so much the brilliancy of thought to conceive as the persistence and confidence to put through. Plenty of our cities have wise plans made by those who know how to do just this but they are now merely dusty papers on forgotten shelves. Possibly the mayor of New York has hit upon a way to make a city plan effective. If he has he is entitled to a patent, on the grounds of novelty.

Cost-Plus Comes Back

THE cost-plus contract for certain important drainage work in St. Louis, Mo., described in our last issue, is a significant return to a method of contracting construction which was virtually killed in public works practice by the war. It was the lot of the cost-plus contract to be accused of all the extravagances and wastes of war construction. However unjust this was perceived by the thinking engineer to be, few had the courage to combat popular prejudice. This has been particularly true of public works engineers. Indeed following the charges of fraud and the suits for restitution against the war contractors a public works engineer risked his position, and almost his reputation, if he advocated cost-plus contract construction. The distrust of the method even extended to private construction and cost-plus contracting which had been steadily growing in favor began speedily to decline. Only the reputation of a few outstanding contracting organizations which had made the practice a fundamental of their operations kept it alive. Gradually, with the return to more normal conditions, there has been a return to favor with private owners of cost-plus construction. It still remains in scant favor in public works construction and it is this fact which magnifies the action of the St. Louis board of public service. It is not now the occasion to discuss cost-plus contracting. All its phases have been contended time and again by its disciples and its opponents. When the St. Louis experiment is recorded as we expect it will be, there will be new facts to guide opinion. For the moment, however, it can be said that cost-plus contracting possesses advantages under many conditions which make it well worth an owner's most careful attention.

A Re-invigorated Movement

FROM the evidence furnished by its convention at Philadelphia last week, the American Association of Engineers has reached a stable and sound condition. The membership, which for a time was sagging steadily and at an alarming rate, now is not only maintaining itself but is growing; expenses have been reduced below income and a saving is made; in addition, the divergence of purpose that marked previous conventions has been overcome. These are signs of excellent augury. They are important not only to the friends of the Association, however. The year's development—for the past year was the time of reform—should serve to demonstrate to all engineers the profession's needs. It makes manifest the demand for professional as contrasted with technical activities.

"Professional welfare work"—not a very graphic term at best—describes something that is not contained in technical discussions of stresses or the like and yet is a practical business necessity of the engineering community. It concerns the engineer as a man who must live, who must live efficiently, and who must work out many puzzling problems arising from the intermixture of ethics, technical skill and business exigencies. There was a time when such work was decried as uncalled for, as being below the level of a self-respecting society, but the passing days have made this view obsolete. Today it is clear that there is proper scope for society work in this field. The technical societies, hitherto inclined to ignore its necessity, can hardly continue long to look askance upon it under present conditions. The time may have come for them to consider seriously the possibility of co-operating with the Association, in order that technical activities and professional activities may be worked out in helpful conjunction.

The plain fact is that more than 6,000 men of the profession are engaged in the new work, and—after some initial confusion—remain grouped together in orderly, well managed array. These men are soberly intent upon bettering professional life in its administrative, ethical, social and public-service phases. They can achieve success unaided; but they will do so more quickly, and will help the profession more effectively, if their work is understood and is sympathetically supported by the technical societies. Much remains to be done in developing the purpose of the professional movement and centering it on suitable objectives. The ultimate value and need of the work, however, is no longer in doubt.

Train Control Again to the Fore

ONCE more a passenger train running at a high rate of speed at night has plowed its way into the rear sleeping cars of a stalled passenger train ahead of it with an appalling loss of life. Once more the human element in the system built up to prevent such catastrophes has failed to function. At this writing it is not known definitely in what way. Possibly it will never be known because two of the three men primarily responsible are dead, victims of their own or their fellow's carelessness. The rear flagman of the standing train says that he went out 700 ft. (an entirely inadequate distance with such high-speed trains), put down torpedoes and lit a red flare before returning to his train which was just ready to move off when the accident happened. Lacking positive evidence to the contrary, this statement must be accepted as true.

If it is true, then the evidence against the present method of protecting trains is more damning than ever. Usually there are only two men on the front end of a passenger train responsible for the observation of danger signals. This time there were four. If none of these four men neither saw the red flare on a dark night, nor heard the detonation of the torpedoes, nor smelled the tell-tale odor of the latter, then indeed some additional method of protecting trains is necessary. An additional means is available in automatic train con-

trol. It may not be infallible, but certainly it can be counted upon to act in a great majority of emergencies such as this.

The railroad companies have opposed train control installation on account of the high cost and because its development is largely in the experimental stage and future developments may necessitate expensive changes. But the railroads, particularly those which operate high-speed passenger trains as close together as were these two passenger trains last Thursday night, are not as poor as they were when the first order for the installation of automatic control was issued. There is no reason now why the installation of automatic train control devices on the more important railway lines should not be pressed with vigor. It is sometimes claimed too, that such precautions would induce a false sense of security which would render more fallible the already fallible enough human element. But this is, at least, to be proved.

The responsibility for the recent accident is assumed to rest with some member of the train crews. How long will it be before the moral responsibility for a similar accident is shifted to the directors of the company which operate such high speed passenger trains without providing the additional protection of automatic train control?

Engineering as an Aid to the Farmer

THE farmer has a hard row to hoe. He puts in long hours to produce vital supplies which he sells at a low figure for city dwellers working short hours at high wages, who in turn produce goods which the farmer is compelled to buy at high prices, or go without. He has to struggle to get, keep, and pay such labor as he and his family cannot supply with their own hands. His business is so organized, largely by its very nature, that he has long periods of seasonal idleness, a fundamental drawback to efficiency of production. Farming, the oldest of the productive activities of man, remains the least affected by those modern methods which have increased man's productivity, and in so doing have likewise increased his capacity for consumption, and his ability to pay for that increase.

Other great industries have met changed conditions by large scale production, are drawing on great pools of capital by labor-saving machinery, by scientific research, and by utilizing to the full the services of the engineer. Many things conspire to keep the farmer behind the other classes of producers in such modern adaptations. Millions of capital en masse do not exist for the farmer as for the manufacturer, or the transporter, or the distributor of goods. Up to the safe mortgage limit, land or chattel, he can borrow money, but only as an individual. His is indeed a large class of highly individualized and widely scattered persons. He has made his gestures toward co-operation, and they are becoming gradually more effective, in spite of the fact that those who represent him sense his political power more than they seek his individual prosperity, with the result that his accomplishments in co-operation are most notable where they perhaps do him the greatest harm in the long run, that is, in getting class legislation.

No wonder then that he or those who represent him are continually exploring new economic wildernesses in the vain hope that somewhere, somehow, will be found the formula of escape. Free silver in the nineties and equalization fees in this year of grace bear little resemblance as basic means, but the ends sought are precisely the same; they both represent the struggling effort of the agricultural producer to lift up this one great essential of living to the same scale and base as its eternally warring brother, industrial production. All such efforts are expedient. They can affect, if at all, only the temporary relation of the two great divisions of human activity. In the long run, the pendulum now setting high toward industrialism will turn, and the demand for food and clothing from a factory-covered world will increase the attractiveness of the business of raising the wherewithal for this food and clothing.

Meanwhile there is a gradually growing appreciation of the long-time efficacy of engineering as a saving grace. Economics as exemplified in what is called business may alter earlier results, but those most deeply interested in agriculture appreciate that for the long-time pull it is science which will win out. In scientific research the farmer has had far more done for him than any other great producer. How far he has gone in utilizing the numberless data and conclusions placed at his disposal is another matter; not far, probably, compared with the producers in the industrial field. For the most part, however, this application of science has been highly specialized. It has not until recently recognized any engineering relation, but within the past two decades this has been changed. The science of agricultural engineering is growing up, and that science is slowly making its impress on the struggling industry toward which it is directed. The article in this issue by Professor Ayres is an interesting exposition of how this agricultural engineering has grown, and how its development in our schools is progressing.

It would be instructive to know how much the present plight of the farmer is due to his lack of appreciation and use of engineering services. When it comes to employing competent engineers, what percentage of the farmers of the country, even co-operatively, have ever paid a dollar to an engineer, except for surveying? Where it has been done, it has been generally for laying out drainage or irrigation work, or perchance roads, and generally through governmental agencies at that. Indirectly the farmer gets the benefit of a large amount of engineering and other technical service, through the purchase of farm and house equipment, but he does not recognize that as engineering. The forward looking farmer is fully appreciative of the advances that have been made by the scientific agriculturist. That the engineer, too, has something to offer has not as yet made much progress in his consciousness. And yet, to cite only one fairly remote example, those efforts to market his products which are slowly going forward under the head of co-operative plans, are at bottom merely engineering devices, or they are subject to those investigations, analyses and actions that form the basis of engineering operation.

If the farmer as a class will gradually get away from the idea that some kind of magic formula or legal device will act as substitute for scientific development he will, helped out by the normal swing which is bound to come toward his industry, move even faster than he is now moving toward that equality of reward with the industrial producer which he now so eagerly seeks, and which in a properly balanced world he must have.

Laying Intake Through Earth Dike Under Service

Intake for New 90-m.g.d. Filters for Denver Water-Works Put Through Marston Lake Embankment in Cofferdam, but Subaqueous Pipe Placed by Divers from Barges

IN CONNECTION with Denver's new 70-m.g.d. mechanical filtration plant recently installed on the north side of Marston Lake, a 90-in. reinforced-concrete intake pipe was laid through a 40-ft. dike out into the lake, a distance of nearly a quarter of a mile, and a screen house was constructed at the shore end of this line a few hundred feet from the aeration basins of the filter plant. At the start a short section of the pipe with concrete cutoff collars was laid in a cofferdam in the center of the dike and backfilled. The subaqueous pipe was brought down a track laid on the slope of the low-water level. The elevation of the natural ground at the point where the new intake pierces the embankment is about 340 so that the embankment is approximately 30 ft. in height. Water in the lake varied all the way from 345 to 356 while the construction of the pipe line was in progress, the pipe being laid in from 12 to 20 ft. of water.

Screen House—The screen house is a concrete structure up to the level of the top of the embankment and has a brick superstructure. The concrete walls and floors are founded on bedrock which is approximately

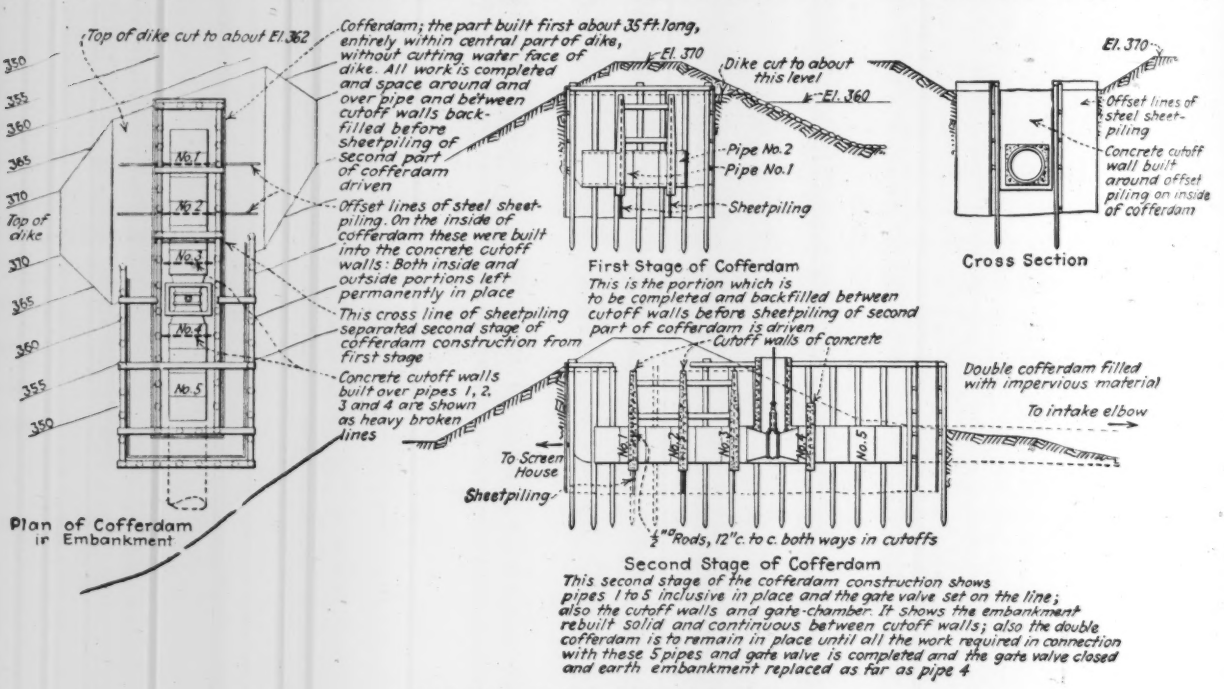

Top of dike cut to about El. 362
Cofferdam; the part built first about 35 ft. long, entirely within central part of dike, without cutting water face of dike. All work is completed and space around and over pipe and between cutoff walls backfilled before sheetpiling of second part of cofferdam driven
Offset lines of steel sheetpiling. On the inside of cofferdam these were built into the concrete cutoff walls: Both inside and outside portions left permanently in place
This cross line of sheetpiling separated second stage of cofferdam construction from first stage
Concrete cutoff walls built over pipes 1, 2, 3 and 4 are shown as heavy broken lines
Top of dike
No. 1
No. 2
No. 3
No. 4
No. 5
Plan of Cofferdam in Embankment
El. 370
Dike cut to about this level
El. 360
Pipe No. 2
Pipe No. 1
Sheetpiling
First Stage of Cofferdam
This is the portion which is to be completed and backfilled between cutoff walls before sheetpiling of second part of cofferdam is driven
Offset lines of steel sheetpiling
Concrete cutoff wall built around offset piling on inside of cofferdam
Cross Section
Cutoff walls of concrete
Double cofferdam filled with impervious material
To intake elbow
To Screen House
Sheetpiling
½" Rods, 12" c. to c. both ways in cutoffs
Second Stage of Cofferdam
This second stage of the cofferdam construction shows pipes 1 to 5 inclusive in place and the gate valve set on the line; also the cutoff walls and gate-chamber. It shows the embankment rebuilt solid and continuous between cutoff walls; also the double cofferdam is to remain in place until all the work required in connection with these 5 pipes and gate valve is completed and the gate valve closed and earth embankment replaced as far as pipe 4

FIG. 1—DETAILS OF DIKE CROSSING

embankment into the water, transferred to a barge from which it was sunk in place and brought home by a diver. A cone-shaped frame on the upturned elbow at the intake end is covered by a conical screen guided to place by a chain from the frame paying through the top of the screen to the surface.

Marston Lake, being a 6,000-m.g. uncovered reservoir, is subject to a rather profuse growth of algae which thrive in clear shallow water under the action of sunlight. For that reason it was considered desirable to draw the water from a point some distance from the shore where there is always a considerable depth and where the growth of algae is minimized. The 90-in. intake will provide not only for the present capacity of the filter plant but also for future extensions.

The lake is roughly circular in shape with an average diameter of a little over one mile; and an earth embankment, the elevation of the top of which is 370, Denver datum, extends around most of its perimeter. The bottom of the lake at the new point of intake is below El. 320 so that the depth there at high water is more than 40 ft. and more than 20 ft. at proposed minimum at El. 312 or about 30 ft. below the natural ground level. The structure is pear-shaped in plan, Fig. 3, inside dimensions on the major axes being 38 ft. and 44 ft. respectively. The structure is provided with the necessary concrete piers and steel and concrete appurtenances for three sets of traveling screens. These screens have a height of 60 ft. c. to c. of sprockets and are provided with screen baskets 8 ft. long. They are designed for a speed of travel of 6 ft. per minute. Two of the screens have No. 40 copper mesh wire and the third screen has No. 60 copper mesh wire.

As the ground was quite wet above bedrock, due to seepage through the embankment, a sheetpile cofferdam was driven down to bedrock around the location of the concrete structure before excavation was started and four 12x12-ft. wooden key piles were driven inside the cofferdam to afford a means of bracing during the progress of excavation and concrete construction. The sheetpiling was left in place and used as an outer form for the lower part of the concrete walls. The cofferdam, Fig. 2, was excavated with a clamshell bucket on a crane which also was used for handling concrete.

The pipe line is provided with a vertical elbow at the intake end, a 60-ft. valve in the embankment about 75 ft. from the south wall of the screen house and a steel breeches which connects with the 90-in. line where

FIG. 2—EXCAVATING FOUNDATION OF PEAR-SHAPED SCREEN HOUSE
Sheeting was driven to bedrock and used for outer form for concrete walls. Note proximity to toe of dike.

it enters the screen house and branches into two 54-in. down pipes provided with valves at approximately El. 325. Special steel reducers 6 ft. long, with ends of necessary shape for calking into the steel ends of the concrete pipe, provided for connection to the 60-in. flanged valve. The pipe line must act as a siphon when the lake is at a low level and provision is made for pumping the air out of the line at a high point near the screen house so as to start the action of the siphon. This necessitates an airtight pipe line in the first 200 ft. of pipe line laid south of the screen house. To provide for airtightness, welded steel cylinders of No. 12 gage steel made integral with the steel joint rings by welding were molded into the walls of the pipes when they were manufactured and the calked lead joints used in this design of pipe were also made airtight without difficulty. All pipe laid in the lake was manufactured in 12-ft. lengths weighing approximately 15 tons each or 8½ tons when submerged in water. For convenience in handling, the pipes laid on shore were manufactured in 6-ft. lengths. As the pipe laid by subaqueous methods operates under no head, having substantially the same pressure inside and outside, it was not found necessary to calk the joints or fill the joint space with mortar beyond the end of the section acting as a siphon. To prevent any tendency for the pipes to separate all pipes laid under water were provided with a pair of 1½-in. eyebolts at each end, which were driven into steel nipples molded into the concrete during manufacture, all of them being in the same plane. The pipes were laid with these eyebolts on the horizontal axis and 1½-in. bolts were inserted through the eyebolts by the divers and nuts screwed home.

Pipe Delivery—All pipe laid on shore was delivered by truck. It was the intention to load the subaqueous pipe on the laying barge from a dock but the lake level was considerably lower than was anticipated. Accordingly, a railway track of about 5-ft. gage was laid from the manufacturing yard down the east shore of the lake and out into the water several hundred feet. Each pipe was loaded on a low pipe car which ran on this track, Fig. 4, and which was pulled out into the lake by a hoisting drum on the barge to a point where the depth of water was sufficient to give flotation for the loaded barge. The pipe was then picked up by the barge and transported to the location of the pipe line where it was laid. The empty car was pulled back to the loading yard by a cable on the drum of the locomotive crane, this cable being eased off gradually to steady the car when delivering pipe.

Before delivery, each subaqueous pipe was provided with a heavy strap-iron band placed around the pipe at its center of gravity and to facilitate handling, a pair of eyes was welded on top of the band near the 45 deg. points. From the pipe handling device on the barge a Y-shaped bridle was hung which consisted of a pair of short eyebars, the ends of which engaged the

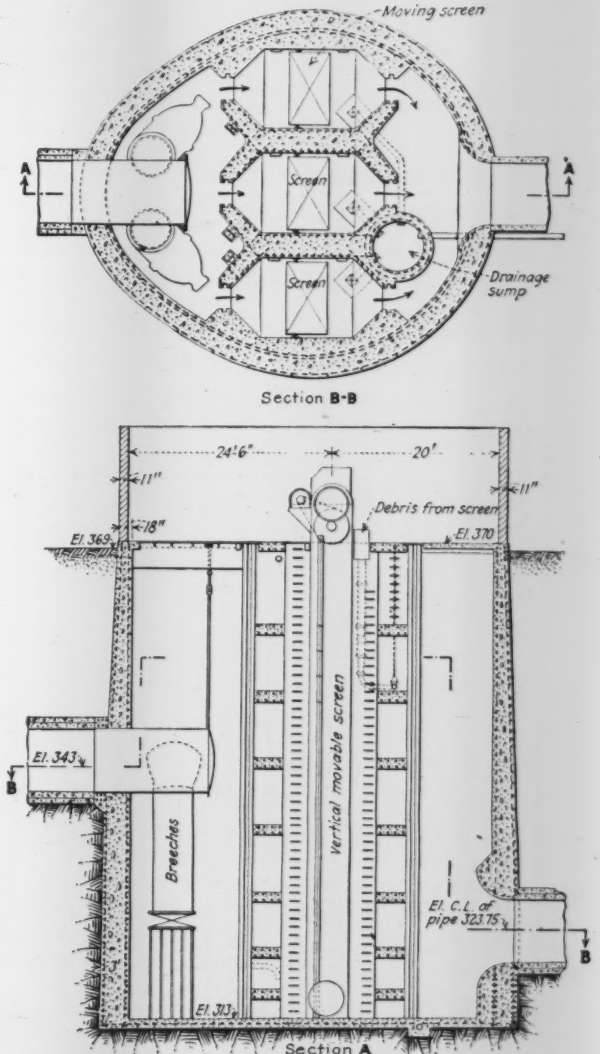


FIG. 3—PEAR-SHAPED SCREEN HOUSE FOR THREE TRAVELING SCREENS

eyes on the pipe band and were secured by steel pins to which ropes were fastened so that they could be easily removed after the pipe was laid and the load slackened off. The steel bands were left in place on the pipes.

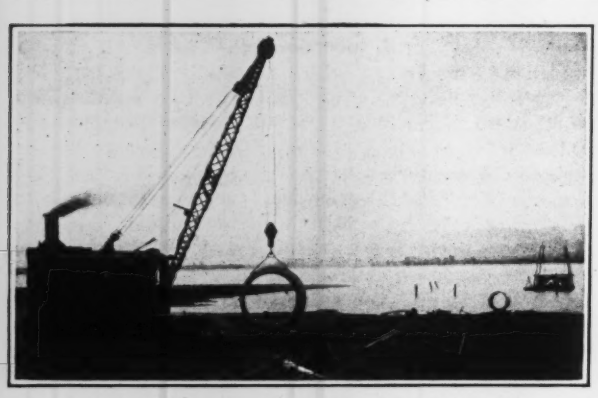


FIG. 4—CRANE DELIVERS PIPE TO RAILROAD DOWN SLOPE

Flat car carrying pipe near water edge let down slope with cable. Barge will pick up between pontoons when pipe far enough out for barge to get it.

According to the specifications the first stage of the work was to be the construction of a cofferdam in the main body of the embankment and this cofferdam was to be excavated and the pipe laid and fully protected by the necessary concrete cutoff walls and earth backfill before the water face of the embankment was disturbed. Percolation of water along the sides of the cofferdam during construction or along the pipe after it was laid might readily develop a condition of erosion which could undermine the embankment. The cutoff walls were to be extended out 8 ft. beyond both sides of the cofferdam and at right angles to it by driving full length interlocking sheetpiles made structurally intact

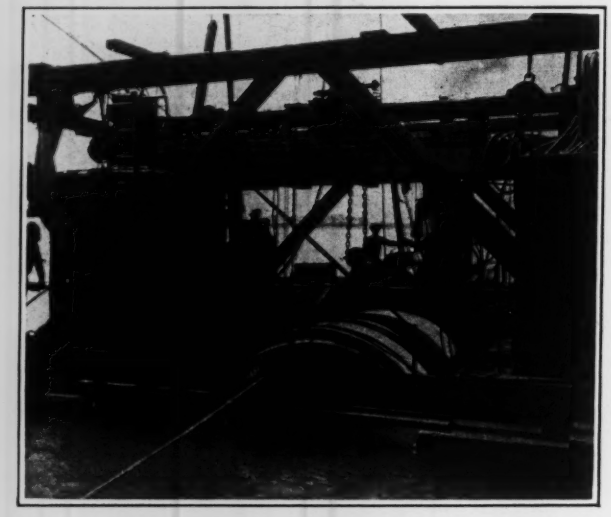


FIG. 5—LAYING BARGE WITH PIPE READY TO LOWER

Four spuds steady barge which is pulled to final position by lines moored to buoys. Four guy ropes were fastened on each side of the pipe at both ends. Laying rig supported on transverse track. A chain block fastened to the sling gave a longitudinal motion and four guy ropes provided slight adjustment in alignment.

with the cofferdam. As soon as the cofferdam excavation was completed sheet piles, 8 or 9 ft. long, were to be driven across the bottom below subgrade along the line of a cutoff wall and when the pipe was laid a concrete collar or curtain was to be placed around it, bonded to the sheetpiles in the bottom and to sections of piling on the inside of the cofferdam interlocking with the walls so as to give an impervious cutoff wall at least 32 ft. wide and approximately the same height.

Before any cofferdam work was started a wide prism of earth was excavated from the top of the embankment its full width down to elevation 360.

The first cofferdam was made up of a single row of steel sheetpiles forming a complete box about 17 ft. wide and 40 ft. long, the north end being about 30 ft. from the south wall of the screen house which is at the down-stream toe of the embankment. It was provided with the necessary corner pieces and six crosses so that the steel piling in the cutoff walls could be made structurally intact with the concrete collars around the pipe. Twelve 12x12-in. timber piles about 40 ft. long were driven inside of the cofferdam at the corners and along the sides, which served as a framework for the timber bracing of the cofferdam, and the 12x12-in. rangers framed on these posts also supported heavy cross-timbers which served as a mat for the crane used in excavation, piledriving and pipe laying. Six pipes, 6 ft. long or 36 ft. of pipe, were laid in this cofferdam and three combined concrete and sheetpile cutoff walls 33 ft. wide, were constructed across it. Reinforced-concrete struts were placed between the concrete collars so that they could act as retaining walls to take care of any

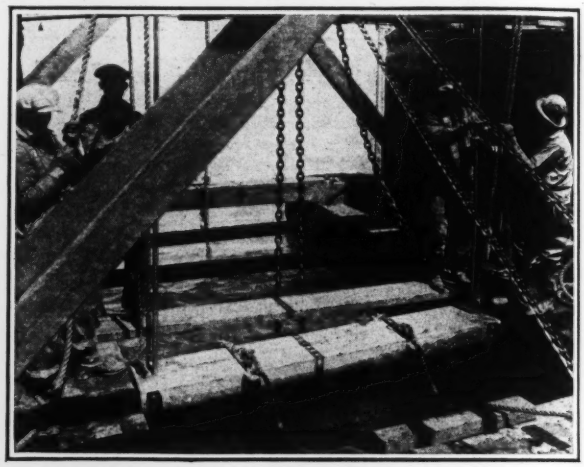


FIG. 6—THE 6x16-IN. SILL WITH ANGLE BARS AND WEIGHTS

unbalanced pressure which might develop during backfilling or while the embankment was settling.

The second cofferdam had practically the same dimensions in plan inside as the first and was constructed in substantially the same manner, but a double row of steel sheetpiles were driven around the portion which was out in the water, the space between the two rows of piling being filled with impervious material. In addition to the 60-in. valve, which with the reducer occupied a space of about 14 ft., four pieces of pipe, 6 ft. long, were laid in this cofferdam. One low cutoff wall was constructed on this cofferdam and a concrete valve chamber, 6x10 ft. in plan inside, was built over the 60-in. valve.

A third cofferdam was constructed out in the water so as to drop the pipe line down about 7 ft. in a distance of 36 ft. This cofferdam was built in extension of the second cofferdam in water varying in depth from 10 ft. to 15 ft. Only a single row of sheetpiles was used in this cofferdam. It was protected from seepage by a large piece of heavy canvas which extended completely around the outside of it, and placed around the bottom of the cofferdam acted effectively as a water seal.

All piling in the first cofferdam and the inner row

of the second cofferdam was left in place. The outer row of piling in the second cofferdam and all sheetpiles in the third cofferdam were pulled with the crane. All concrete pipe and steel specials laid in the cofferdams were concreted in the full width of the cofferdams from subgrade up to a point 8 in. above the top of the pipe.

Piling 32 ft. long, similar to that described for the screen house cofferdam, was used for the cofferdams through the embankment and it was driven with a steam hammer, the leads for which were supported

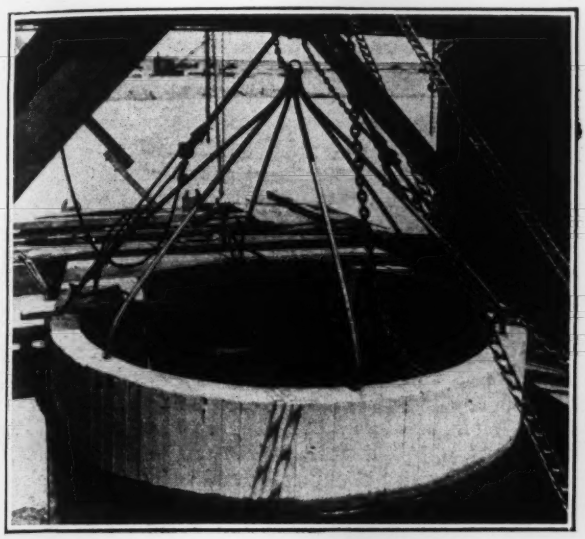


FIG. 7—CONCRETE ELBOW AND GUIDE FOR SCREEN

from the boom of the crane. Most of the excavation was done with clamshell and orangepeel buckets. A 10-ton crawler crane was used for piledriving, excavation, pipe laying and backfilling.

Pipe Laying in the Lake—The improvised barge, Fig. 5, used for the delivery and laying of the subaqueous pipe, consisted of twin rectangular timber pontoons, each 26 ft. long and 9 ft. wide with an overall depth of 34 in. They were provided with watertight decking to prevent waterlogging. They were fastened together with a space of about 9 ft. between them so as to give a few inches clearance for a 90-in. pipe, which has an outside diameter of 8 ft. 4 in. Across the barge a heavy gallows frame was constructed on top of which an 18-in.-gage track was placed for the geared pipe-handling rig. Astern of the twin pontoons, with its axis on the longitudinal axis of the barge, a third pontoon was fastened. This supported a steam hoisting engine which furnished power for driving the propellers, one of which was placed at the stern of each of the twin pontoons and which also drove a counter shaft which furnished power for the laying rig and the winch heads used to operate the spud and mooring lines. The main anchor was operated by one of the drums. The barge had a very narrow freeboard and drew nearly 33 in. of water with its fixed load and the maximum movable load of about 15 tons. In taking on a pipe from the delivery car the barge was anchored in position astraddle of the railway track and the partially submerged pipe resting on the delivery car was pulled in between the twin pontoons.

Four long spud posts were provided, one at each corner of the barge; they were raised and lowered by manila ropes wound on winch heads. These spuds served effectively in steadying the barge while at anchor and were very useful when manipulating the barge into exact position. The barge was also equipped with a removable boom and pile driver leads. In loading or laying pipe, the barge was brought to approximate position on its own power and pulled to final position by lines moored to buoys, which were shifted as the work progressed. Very careful manipulation was required as the barge had to be brought to exact alignment and distance within a few inches when laying pipe.

In order to minimize the difficulties of laying by making the pipes go together easily, special care was taken to keep on exact grade and line. Before a pipe was laid, a wooden sill 16 in. wide and about 6 in. thick, Fig. 6, was placed in the bottom of the lake at right angles to the pipe line a foot or so back of the point where the end of the bell was to come. The sill was provided with an angle-iron leg at each corner and when lowered into the water was weighted down by means of removable saddles fastened to lead weights, guides being used to bring the sill to the proper position after which it was rammed to exact grade by means of two specially devised tampers made up of

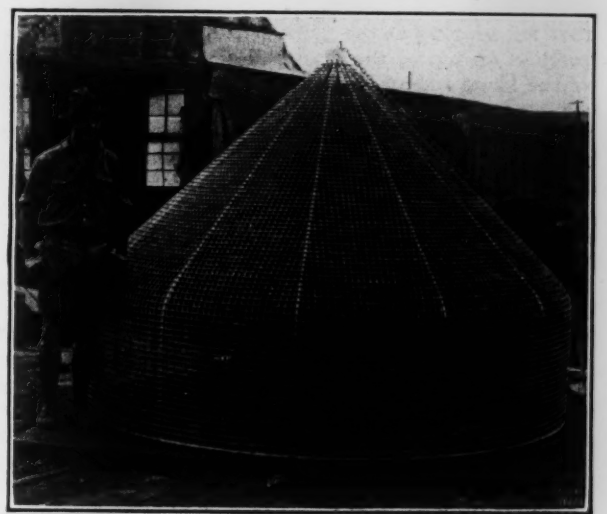


FIG. 8—SCREEN FOR TOP OF ELBOW LET DOWN ON GUIDE CHAIN

Guide chain from frame pays through ring at top of screen. A second chain on screen enables screen to be pulled up for cleaning. Both chains are attached to a buoy.

angle irons and pieces of sheetpiling. Before the sill was lowered exact soundings were taken to determine the contour of the lake bottom so that a sill of necessary thickness could be provided or blocking nailed on the underside of the sill to fill up depressions. In case the sill was driven below exact grade, it was an easy matter to nail a scab on top while in position under water.

The pipes were laid bell end forward and in laying the spigot end was carefully aligned on the bell of the pipe last placed by means of four guy ropes fastened on each side of the pipe at both ends. The pipe-handling or laying rig which was supported on a transverse truck gave a motion in two directions, that is, up and down and sideways. A chain block fastened to the sling gave a longitudinal motion to the pipe and the four guy ropes provided for slight adjustments in alignment, so that it was a relatively simple matter to bring

the pipe home to exact position. When this was done, the diver entered the tie bolts through the eyebolts at the ends of the pipe and placed the nuts on them, after which they were tightened up by means of a ratchet wrench operated either by the diver or by a rope from the barge.

Line which was on a tangent was carried by means of range poles on shore and in the lake, it being occasionally checked up with a transit. Grade was carried by water level corrected for changes in gage height, or when the lake was rough, by rod measurements from pipes already in place.

After pipe laying was finished, pea gravel was spilled along either side of the pipe line through slots in the sides of gravel boxes transported along the center line by the barge. The gravel was well worked under the haunches of the pipe by the divers so as to insure a firm and permanent foundation.

Conical Screen—A precast reinforced-concrete elbow, provided with a spigot joint ring to engage the bell of the last pipe, was installed at the end of the pipe line. This elbow, which weighed nearly 20 tons, was lowered into place by the barge. Just before lowering, a conical screen frame consisting of six heavy brass rods with a ring at the point of the cone was placed in position on top of the open end of the elbow, the feet of the brass rods fitting into holes left in the concrete during molding. A chain fastened to the ring of this frame serves as a guide for the screen which was installed later. The screen, Fig. 8, which is also conical in shape and which is made up of brass rods braced or soldered together, has openings 1 in. square in the clear. There is a hole in the brass casting at the top of the screen and a brass clevis provides a means of fastening the screen to the chain by which it is handled. When the screen was lowered into place, the guide chain on the screen frame was passed through the hole in the brass screen casting and the screen dropped readily into exact position with its bottom ring on top of the concrete elbow. The ends of both chains are fastened to the buoy which marks the end of the intake and the screen can be easily raised for cleaning.

Laying of pipe in the lake was started at the end of March, 1925, and finished early in May so that the job of laying 98 pieces of pipe took about 30 working days. Five pieces of pipe were frequently delivered and laid in one day, but wind, which is prevalent in Colorado at that season of the year, interfered materially with the progress of laying, not only because of the roughness of the water but because of the danger of the barge being grounded in the shallow water on the east shore where the pipe was loaded.

The Lock Joint Pipe Co. handled all pipe manufacture, pipe laying and cofferdam construction with its own forces; and Stearns-Roger Manufacturing & Supply Co. of Denver constructed the screen house. The total amount of the contract for the pipe line and the screen house was about $315,000.

Burton Lowther, chief engineer of the Denver municipal water-works, was in general charge of all water-works construction for the city and Walter A. Sumner was resident engineer on this job. James H. Fuertes, of New York, was designing and consulting engineer and was represented on the job by Fred H. Weed, resident engineer.

Compromise Arrangements Made in Railway Plans in Oregon

Interstate Commerce Commission Authorizes New Construction—Does Not Order All Lines Requested by State

CONFLICTING plans for new railroad construction in Oregon have been before the Interstate Commerce Commission for nearly two years. Beginning with the request of the Oregon Public Service Commission that the Interstate Commerce Commission order the construction of some 400 miles of railroad in the central portion of Oregon (*Engineering News-Record*, Oct. 16, 1924, p. 635) and followed by several applications from individual railroad companies for authority to build lines in the same region, the matter has become one of more than usual interest not only because of the large mileage involved but also because the commission was asked to order the construction of a considerable mileage of railroad, which in the opinion of the railroad companies concerned was not warranted on the basis of the revenue in view. Because of these circumstances, the Interstate Commerce Commission decided to consider both the complaint of the Oregon Public Service Commission and the application of the railroad companies at one time. This has been done and on May 3 the commission issued an order, outlined briefly in our issue of May 27, p. 875, dismissing the complaint of the Oregon Public Service Commission and authorizing the construction of about 360 miles of railroad, the authorization being conditioned upon the granting of certain operating rights among the railroads concerned.

In the eastern half of Oregon is a great plateau region about 4,500 ft. above sea level reached only by a few stub-end railroad lines and hardly any highways. The center of the region is semi-arid, but in the north and west it contains large stands of timber and in the south and east are many settled areas. The Oregon commission sought not only to open up this area for development by the construction of an east and west line of railroad and a north and south line across it, but also by these lines to provide a new route to carry the products of western Oregon to the eastern market. These products now move over the lines of the Great Northern, Northern Pacific, or Chicago, Milwaukee & St. Paul to the north and eastward, or southward and eastward over the lines of the Southern Pacific by way of Roseville, Calif., and Ogden, Utah. The Oregon commission sought the construction of an east and west line from Oakridge to Crane, which would give a new route to the east at least 420 miles shorter than the route by way of Ogden, and the construction of a north and south line between Klamath Falls and Bend, with a connection to Oakridge, which would give an additional north and south route and would increase the competition in the region around Klamath Falls which now is tributary to the Southern Pacific and its controlled lines only. Moreover, the Oregon Commission requested that the Interstate Commerce Commission order the joint use of the new railroad by the major railroad systems with which they connected in order to increase competition.

The new lines proposed by the Oregon commission would connect with the Great Northern and Union Pacific systems on the north, with the Southern Pacific on the west and south, and with the Union Pacific system on the east. In order to establish the new route for

products of western Oregon across the state, the Southern Pacific would have to turn over to the Union Pacific freight which it now handles southward and eastward through Ogden, and the Union Pacific, the Great Northern and the St. Paul would be required to turn over freight to the Southern Pacific to be routed to the new transcontinental route. The railroads were actively opposed to any such arrangement and the Interstate Commerce Commission, in its decision, stated that the construction by the Union Pacific of its line across the state from Crane to Oakridge (as proposed when construction of this line was started, the Union Pacific then being affiliated with the Southern Pacific) is not economically feasible now that the two systems are independent. On the other hand, the commission considered that the construction of additional north and south

EXISTING AND PROPOSED RAILWAY LINES IN OREGON

lines is economically justified and desirable from a point of developing the territory, but it expressed itself as being opposed to the construction of paralleling lines and as favoring the joint use of certain lines, at least until there is sufficient traffic developed to require the construction of additional lines.

In view of these considerations, the Interstate Commerce Commission declined to order the large amount of new construction requested by the Oregon Public Service Commission but authorized the railroad companies to build lesser amounts as follows:

Oregon, California & Eastern Railway Co.—The Oregon, California & Eastern Railway Co. is authorized to construct a line from its northerly terminus at Sprague River north 63 miles to Silver Lake, with a branch from a point on this line 20 miles north of Sprague River in a northwesterly direction along the Williamson River approximately 15 miles, and another branch from Sprague River southeasterly 65 miles to Lakeview. Authority to build these lines is given upon the condition that the Oregon Trunk Ry. be granted the right to operate either over the Southern Pacific line from Paunina to Klamath Falls or over the tracks of the O., C. & E. Ry. to Klamath Falls from a connection on the proposed Williamson River branch described above.

Oregon Trunk Ry.—The Oregon Trunk Ry. is authorized to construct a line of railroad from Bend by way of Paunina to the nearest practical point of connection with the Oregon, California & Eastern Ry. But there is the condition that if the Oregon Trunk Ry. shall be granted the right to operate over the Southern Pacific from Paunina to Klamath Falls it shall construct only from Bend to Paunina. Construction by the Oregon Trunk Ry. south of Paunina or by the Oregon, California & Eastern Ry. is not to be commenced until a copy of the agreement for operating rights is filed with the commission.

Central Pacific Ry.—The Central Pacific Ry. (Southern Pacific System) is authorized to construct a line of railroad from a point near Klamath Falls southeast to Cornell, Modoc County, Calif., a distance of 36 miles, and thence southeast to a connection with the Nevada-California-Oregon Ry. at Alturas, Calif. As the latter line is narrow-gage it will have to be widened and improved to fit it for part of a main line route.

In addition the Southern Pacific Co. is authorized to obtain control of the Oregon, California & Eastern Railway Co. by purchase of its capital stock upon the condition that the Oregon Trunk Ry. shall be granted rights to operate over either the Natron cutoff line or the Oregon, California & Eastern line into Klamath Falls. The Southern Pacific Co. also is authorized to acquire control of the Nevada-California-Oregon Ry. Co. by purchase of its capital stock.

The Southern Pacific Co. estimates that the total cost of this work will be $19,741,000. This includes purchase, rehabilitation and extension of the Oregon, California & Eastern, purchase and changing the gage of the Nevada-California-Oregon and the new extension from Klamath Falls to Alturas. In addition to this it is now spending nearly $40,000,000 in the construction of Natron cutoff and Black Butte cutoff.

The construction of these lines satisfies part of the requirements of the Oregon Public Service Commission, in that a new and shorter route to the East will be provided from Eugene over the Natron cutoff to Klamath Falls, thence by the new line of the Southern Pacific to Alturas and south over the reconstructed line of the Nevada, California & Oregon Ry. to Wendel. Moreover, the Interstate Commerce Commission, by refusing to comply with the request of the Oregon commission that it order the construction of certain railway lines and then attempting to satisfy the requirements of the latter commission by approving the construction of lines which the railroads were anxious to build, avoided raising the question of its authority to order the construction of any railroad against the wishes of the railroad company so ordered. This action by the commission is reasonably certain to insure the early construction of some or all of the lines now authorized, whereas, had the commission ordered any or all of the railroads to build lines which they were unwilling to build, the whole matter in all probability would have gone to the courts on a test of the constitutionality of the order and construction would have been postponed indefinitely.

Action by the Railroad Companies—Following the publication of this order by the Interstate Commerce Commission, the presidents of the Great Northern Ry. Northern Pacific Co. and the Southern Pacific Co. met to discuss the conditions established by the commission, but have not yet reached any definite agreement.

A Problem in Plant Layout On Saturated Sand

Open Dredging an 82-Ft. Caisson 63 Ft. Deep in Sand Below Tide Level Calls for Pile Foundation for Plant

THE PROBLEM of locating a construction plant on sand constantly wet and certain to move as construction proceeded was interestingly solved recently in sinking a circular caisson 82x63 ft. on the shore of Jamaica Bay on Long Island. Each plant unit was put on a pile foundation and was kept outside a danger zone assumed as a ring 20 ft. wide all around the caisson. The arrangement is indicated by Fig. 1 and the general view Fig. 2 shows the nature of plant and structure.

Conditions of Site—The structure is the first of three 80-m.g.d. units of the new Jamaica sewage treatment

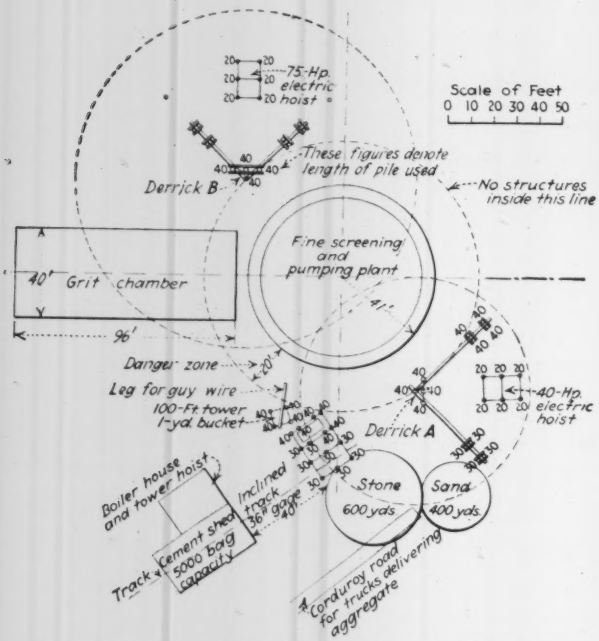


FIG. 1—COMPACT CONSTRUCTION PLANT LAYOUT FOR OPEN CAISSON SINKING JOB

plant for the Borough of Queens, New York City. Each of these units consists of a grit chamber and a circular pit in which are to be housed two 26 ft. diameter fine screens and the pumping plant. Following the completion of the three screening and pumping units, an activated sludge plant will be constructed further to treat the sewage.

At the site, the ground is about a foot below mean high water in the adjacent Jamaica Bay. The sand is continuously saturated. The construction plan determined on, therefore, was: (1) For the shallow grit tank foundations, to keep down the water level by well points and pumping and to concrete in the dry, and (2) for the deep circular screen pit to sink a circular caisson by open dredging and seal the bottom under water. The saturated condition of the site is indicated by the fact that for the grit chamber, a reinforced-concrete structure 96x40 ft. in plan being built in open excavation to El. —23.5, over 200 well points entirely surrounding the structure are connected to a pump discharging 4,500 g.p.m. continuously. Aside from being the direct opposite of the construction procedure used on the caisson the grit chamber work presented little of interest. Indeed the caisson sinking was ordinary except for usual exacting care always necessary.

Plant Layout—Success in sinking the caisson was really a task of careful plant layout. First, the possibility of cave-ins around the caisson as it was being dredged out required that all structures be placed outside a possible danger zone. The contractor determined that this zone should be 20 ft. wide entirely around the structure (Fig. 1). Second, it was desirable to have as few structures as possible. Third, since it was

FIG. 2—GENERAL VIEW OF CONSTRUCTION PLANT

necessary to place the 1,600 yd. in the concrete bottom by a continuous pour, the plant had to have a capacity and operating efficiency to take care of this maximum requirement. The estimated time for this operation was 48 hours.

Two stiff-leg derricks with 70 and 90-ft. booms were so located that the dredging buckets could cover the entire structure. Next the sand and stone storage piles and the concreting plant were placed at equal radial distances from the base of the 70-ft. derrick, marked *A* in Fig. 1. At the same time the concreting plant was placed as close as possible to the edge of the danger zone. The radial distance was chosen so that the boom at a fixed inclination would slightly clear the storage bins above the concreting plant. By this arrangement sand or stone can be transferred from the storage piles to the concreting plant bins by merely swinging the derrick thus eliminating slow and costly "booming."

The location of all of these structures having been satisfactorily determined, there remained the 100-ft. concreting tower. It was not possible to place this directly in front of the mixer discharge and keep outside of the danger zone. It was offset as shown in Fig. 1, and although the flat inclination that was thus obtained from the mixer discharge chute to the tower hopper caused some inconvenience, the arrangement as a whole worked satisfactorily. Counterweight chutes reached all of the caisson wall except a small section on the far side. Guying the tower also presented a problem. Wires across the caisson site would interfere with the derrick booms if carried to dead men. A 40-ft. gin pole was finally erected directly across the caisson and one guy wire fastened to it. A second wire was fastened to a leg on the tower foundation structure and the others were carried to dead men.

From a cement shed of 5,000-bag capacity an inclined

cableway track leads to the charging platform of the concreting plant. This track extends out the opposite end of the shed (Fig. 1) so that trucks can unload onto the flat cars which can then be pulled to the unloading point (either the shed or the charging platform) by the cable. The cable is operated by the tower hoist which is located in the adjacent boiler house. This is the only steam hoist on the job, the others being 75 and 40-hp. electric hoists. The concrete mixer is also run by an electric motor. The concreting plant is usual, consisting of storage bins, measuring hoppers and a 1-cu.yd. mixer. The concreting tower hopper also has a capacity of 1 cu.yd.

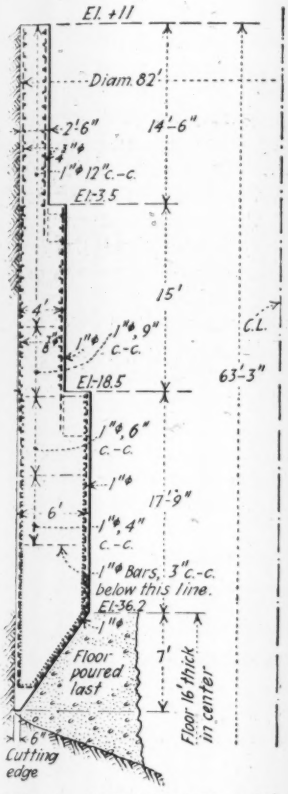


FIG. 3—SECTION OF CAISSON WALL

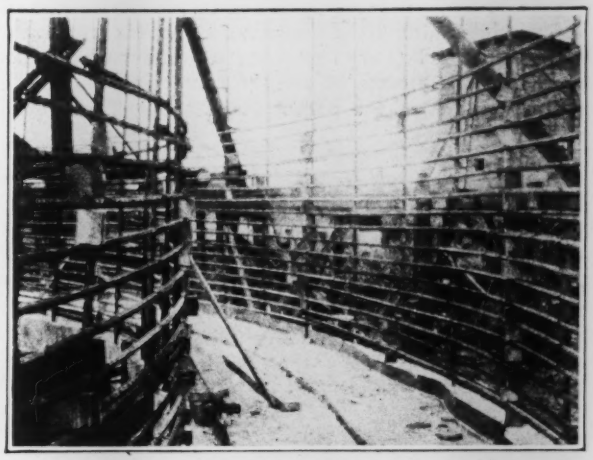
Most of the structures, as shown in Fig. 1, were constructed on piles. The piles near the edge of the danger zone were driven to grade and the wisdom of this procedure was demonstrated when two of the expected cave-ins all but left several of the piles hanging in air. The piles were capped about 10 ft. above the original ground as the contract requires a final sand fill to this elevation. An exception was the concreting tower whose pile substructure was capped practically flush with the ground in order to get the required drop from the mixer to the tower hopper.

All materials are brought in by truck, a corduroy road being built up to the sand and stone storage piles. The loads are dumped on the end of the road and transferred to the piles by the bucket of derrick *A*.

Sinking the Caisson—The section of the caisson shown in Fig. 3 indicates the type of cutting edge used. It was tapered down to 6 in. and heavily reinforced as shown but no steel shoe was used. Wooden forms in sections 8 ft. high and 8 ft. long were placed and removed by the derricks. A total of 2,000 cu.yd. of concrete was poured in the walls.

The first step was to pour an 8-ft. lift of concrete that usually took about 6 hours. The weight of the caisson caused some settlement but the greater part of the sinking was accomplished by dredging, which procedure required the remainder of the week with an average daily sinking of about 1 ft. Derricks *A* and *B* worked together on the dredging, depositing the sand just outside of the danger zone. One man with a 2-in. hose washed the material further away from the work. This resulted in a very low material handling cost. It would have been advantageous to leave the sand in the piles for use in the final fill but the excess weight was felt to multiply the dangers of cave-ins. Construction joints, as shown in Fig. 4, consisted of a keyway and two steel dowel plates. Their use has resulted in an exceptionally watertight structure.

No attempt was made to keep the water out during sinking. Much more than the actual volume of material in the caisson was dredged out for as the pressure on the inside of the caisson was reduced by the removal of material, the sand and water from the outside pushed under the toe. These cave-ins were rather frequent and several times encompassed the whole danger zone but no trouble other than the extra dredging resulted.



TYPE OF CONSTRUCTION JOINT USED
Steel is in place for forms to be raised

The bottom, of mass concrete 16 ft. thick in the center and 7 ft. on the sides, was poured through a tremie hung from the drop line of derrick *B*. On this continuous pour the plant functioned even better than expected and the 1,600 cu.yd. of concrete was poured in 35 hours. Final operations consisted in pumping water from the structure and in the construction of the floors and cross walls to carry the screening and pumping equipment.

Personnel—The Jamaica treatment plant has been designed by the Queens Bureau of Sewers, F. Seely, Assistant Engineer. The Awixa Corp., Islip, N. Y., with Claire D. Schlemmer, president and general manager, is handling the part now under construction.

Concrete Encased Steel Beams Investigated

An extensive series of tests is now in progress at Ohio State University on the strengthening effect of concrete encasement of steel beams. In part these tests parallel those carried out at McGill University a year or two ago, where it was shown that concrete of the usual dimensions and arrangement of haunch encasement applied to concrete floorbeams of buildings or bridges for fireproofing or weather protection purposes acts in full co-operation with the steel as reinforced concrete. This effect was also brought out in certain of the stress measurements on stringers of highway bridge floors by Prof. A. H. Fuller at Iowa State College. In the Ohio tests, a number of old I-beams and built plate girders, some of them badly corroded and weakened in service, were encased in concrete by surrounding them with steel mesh and applying gunite. The elastic behavior as well as the failure loading of the beams showed a great strengthening effect of the concrete. New beams gave a similar result. Tests with poured concrete encasement are also in progress.

Progress and Opportunities of Agricultural Engineering

Thirty-Nine American and Two Canadian Universities Now Offer Instruction—Fields of Service, Opportunities and Occupations of Graduates—Economy of Farm Machinery

By Q. C. Ayres

Associate Professor of Agricultural Engineering, Iowa State College, Ames, Iowa

ORTHODOX readers of *Engineering News-Record* are beginning to ask questions about agricultural engineering. They are beginning to wonder why it has weathered the storms of twenty years' existence as a distinct branch of the parent profession. They revile the editor of "Random Lines" for his grant of immunity and yet are mildly curious to know the reason why. What can agricultural engineers do, they ask, that could not be done as well or better by specialists from the civil, mechanical or electrical fields? Why have leading educational institutions all over the country accorded it such whole-hearted recognition and support? Where do professional graduates in this subject continue to find satisfactory employment year after year?

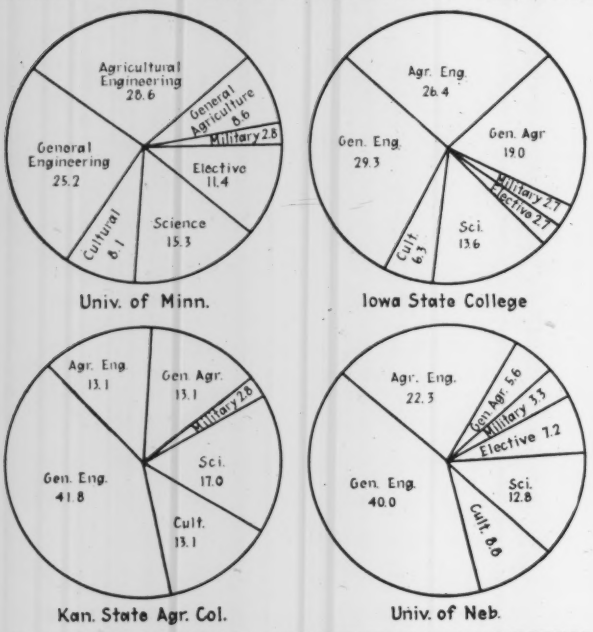


FIG. 1—DISTRIBUTION OF AGRICULTURAL ENGINEERING SUBJECTS AT FOUR AMERICAN UNIVERSITIES

	General Eng'g.	Ag Eng'g.	All Eng'g.	Science	Gen. Ag.	Cultural	Elective	Military
Average	34.1	22.6	56.7	14.7	11.1	9.1	5.3	2.9
Univ. Minn.	25.2	28.6	53.8	15.3	8.6	8.1	11.4	2.8
Iowa State	29.3	26.4	55.9	13.6	19.0	6.3	2.7	2.7
Univ. Neb.	40.0	22.3	62.3	12.8	5.6	8.8	7.2	3.3
Ia. State Ag.	41.8	13.1	54.9	17.0	13.1	13.1	....	2.8

The purpose of this article is to answer these and similar questions which are believed to be of particular interest at a time when agricultural problems are arousing nation-wide attention. The article is not intended as an appeal for converts. Rather is it a mere recital of facts regarding a movement whose record of accomplishment plainly entitles it to a better understanding among engineers.

Origin—Geographically, the movement has centered in the Middle West. Nebraska led off in 1904 by offering simple work in engineering as service courses for agricultural students. From this modest beginning, educational work has spread rapidly until in 1926 such courses were offered in 39 colleges and universities in the United States and two in Canada. During this period 78,000 agricultural students have received specialized instruction. The 1924-25 enrollment was 5,000.

The first full four-year professional course leading to the degree, Bachelor of Science in Agricultural Engineering, was initiated at Iowa State College in 1909. Nebraska and others quickly followed. Today, nine institutions offer degree courses, and such work is on the point of adoption at six others. Altogether, 276 students have received the bachelor's degree in agricultural engineering, 27 the master's degree, and 16 the professional degree of Agricultural Engineer. These figures take no account of the more than 300 old-line engineers who have specialized in this subject for years and are uniformly enthusiastic.

A typical division of subjects in the professional course at representative institutions is shown in Fig. 1. The aim has been to ground the student in the fundamercial sciences and give him sufficient training in general engineering and agriculture to engender a sympathetic attitude and enable him to combine and apply appropriate principles of both.

Functions of Agricultural Engineers—In order to explain the field and functions of agricultural engineers, the following definitions are necessary: Agriculture is the industry engaged in the production of raw material for food, shelter and clothing to fill the needs of the human race. Engineering is the art and science of organizing and directing men, and controlling forces and materials of nature for the benefit of the human race. Agricultural Engineering is the art and science of engineering identified with, and applied to, the industry of agriculture.

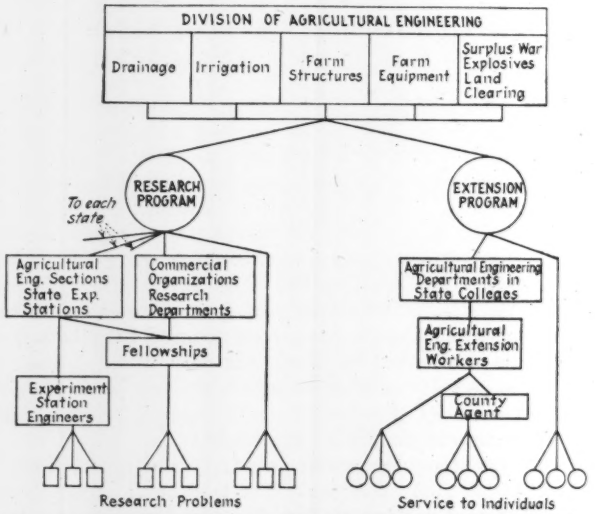


FIG. 2—ORGANIZATION CHART, DIVISION OF AGRICULTURAL ENGINEERING, U. S. BUREAU OF ROADS

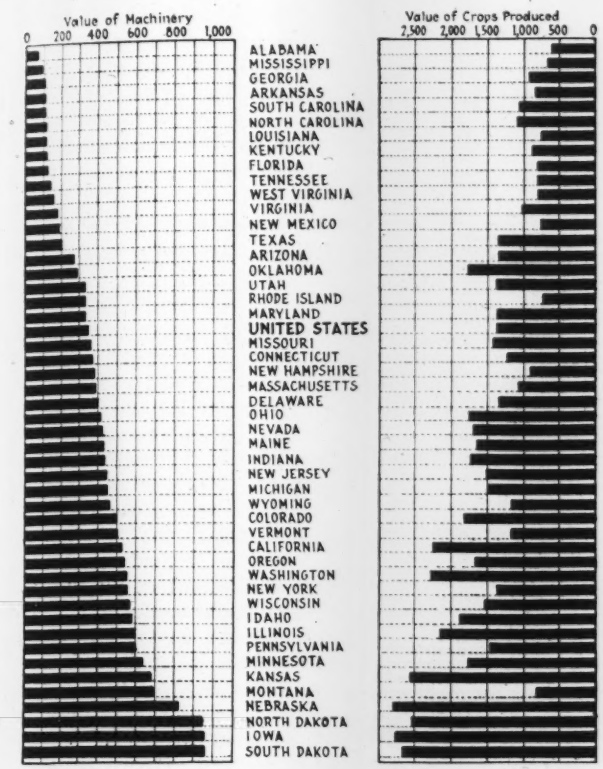


FIG. 3—EFFECT OF MACHINERY ON PRODUCTION PER FARM WORKER, U. S. CENSUS OF 1920

Agricultural engineering, being functional in character and organization, is comparable to mining engineering in its relationship to the older branches of the profession. Just as the mining engineer needs to be both engineer and metallurgist, so the agricultural engineer is both engineer and agriculturist. One is no more a hybrid than the other. In general the purpose of agricultural engineers is to serve the farmer by increasing the productive capacity of the individual farm worker and to assist in applying the income from the surplus produced for those things which contribute to his general well being.

Old-line engineers will not render such service because the field is financially unattractive and they have little time and sympathy to devote to this work even if it should become so. This does not mean that agricultural engineers are poorly paid. On the contrary, their income ranks well above the average for the profession, mainly because they work indirectly through industrial organizations and state and federal institutions, and because competition is not severe. As an example of how some of them function, the organization chart of the Division of Agricultural Engineering, Bureau of Public Roads, United States Department of Agriculture, is shown in Fig. 2.

Fields of Service—The six principal divisions of the agricultural engineering field are: (1) Farm machinery—mechanical equipment used in agriculture; (2) power used in the conduct of agricultural operations; (3) farm structures—rural architecture and the grouping and design of farm buildings; (4) farm and home utilities—water supply, sewage disposal, heating, lighting, ventilation and home equipment; (5) land reclamation—drainage, irrigation and land clearing; (6) power farming—where the use of power and mechanical equipment on a large scale is of major significance.

The introduction and development of farm machinery has been the most important factor in the development of American agriculture. The use of labor-saving machinery increases the productive capacity of the farm worker and makes possible a higher standard of living. The productive capacity of the farm worker has been increased three-fold in 75 years. That a direct relation exists between the value of farm machinery in use and value of crops is clearly indicated in Fig. 3. Fig. 4 shows the number of workers in agriculture that have been released for other pursuits by the use of improved machinery since 1850.

Power is applied by means of farm machinery to farm operations to replace or increase the effectiveness of labor. Fig. 5 shows that power bears the same relation to production per farm worker as does farm machinery. If animal power is included, the total primary power used in agriculture is 40,000,000 hp. which exceeds by 10,000,000 hp. the power used in all manufacturing industries of the United States.

Under normal conditions about 40 per cent of the building construction of the United States is upon the farm. The value of farm buildings comprises 14.7 per cent of the fixed capital of the farms of the United States, which was $77,925,989,073 as reported in the census of 1920. The distribution of this wealth is indicated in Fig. 6. Furthermore the health of livestock and the quality of dairy products is dependent in large degree upon housing conditions and sanitation of barns. Not only that, but the health and comfort of rural life in general depends to a great extent on sanitary, labor-saving and comfort-giving conveniences in farm homes.

Land Reclamation—Any further increase in the productive farm land area of the United States, when

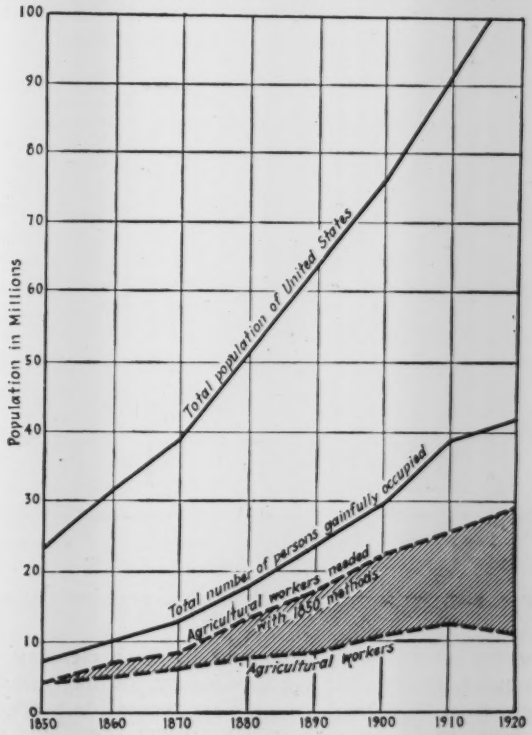


FIG. 4—AGRICULTURAL WORKERS RELEASED BY FARM MACHINERY SINCE 1850

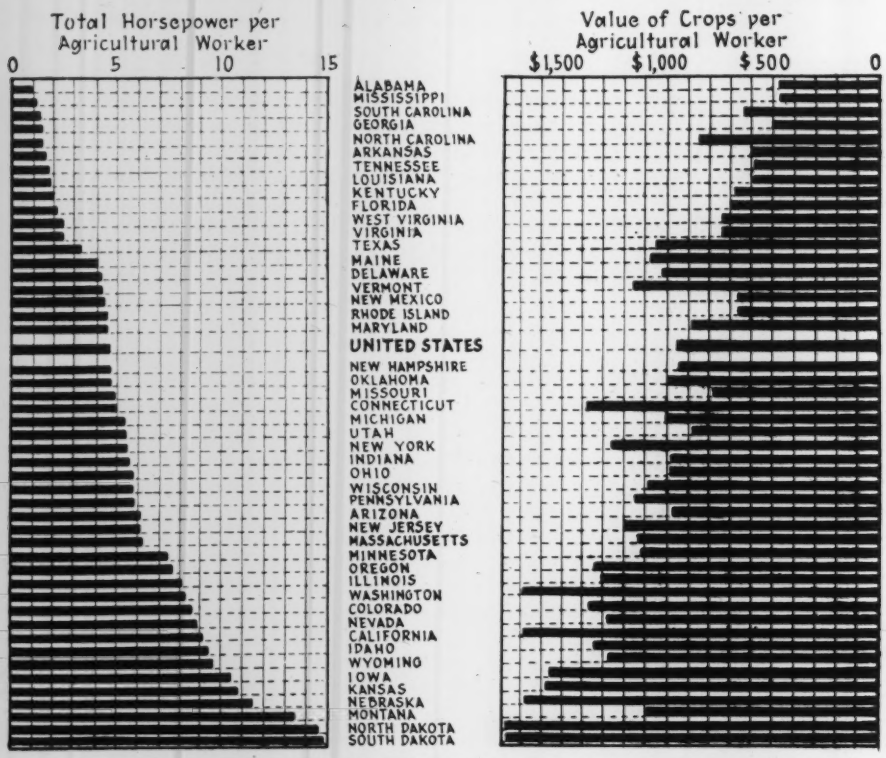


FIG. 5—RELATION BETWEEN HORSEPOWER AND VALUE OF CROPS PER AGRICULTURAL WORKER

needed, must come almost entirely through reclamation of now worthless land by clearing, drainage or irrigation. The potential increase in farm land average by the reclamation of large tracts totals 170,000,000 acres, divided as follows: Cut-over land reclaimable by clearing alone, 50,000,000, and by both clearing and drainage, 60,000,000; reclaimable by drainage and by irrigation, 30,000,000 each. This represents a possible increase of 32 per cent in our present farm land area by the application of engineering methods.

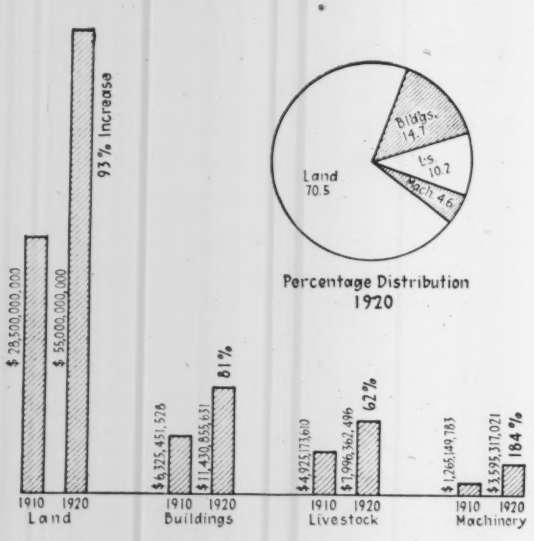


FIG. 6—DISTRIBUTION OF FIXED CAPITAL OF FARMS, U. S. CENSUS OF 1920

According to the census of 1920, 53,024,975 acres of improved farm land were actually benefited or made of more value for agricultural purposes by direct drainage and 65,495,038 acres were provided with outlet facilities by organized drainage enterprises. In 1920, 33,598,699 acres of arid land were included in irrigation enterprises of which 18,218,549 acres were actually supplied with water in 1919. In addition, 39,110,357 acres of farm land were reported as needing drainage in the same census. Much of this occurs as small wet spots in cultivated fields, the elimination of which by drainage would lower the cost of production, make fields uniform and increases the acre-yield. As one line of tile is usually sufficient, no other kind of reclamation offers such large returns on the money invested. During the period from 1910 to 1920, it is estimated that 5,000,000 acres of land have been reclaimed by clearing off second-growth trees and stumps. The land reclamation situation is shown graphically in Fig. 7.

Opportunities for Graduates—Of these several fields, each has drawn its quota from graduates in agricultural engineering. A survey recently concluded by the writer disclosed the facts shown in the accompanying table. A comparatively large percentage of graduates who have gone into education is worthy of note since it emphasizes a wholesome trend in the early years of development and expansion of any profession. It should also be noted that only about 16 per cent are now engaged in some line of work not directly associated with agricultural engineering, which is approximately the normal defection as ascertained by the Society for the Promotion of Engineering Education. A majority of these are working in related lines such as municipal, sanitary and highway engineering. The tabulated data do not show the effects of a definite agreement recently consummated between the colleges and implement manufacturers, whereby the latter agree to absorb a certain number of graduates each year into their organizations.

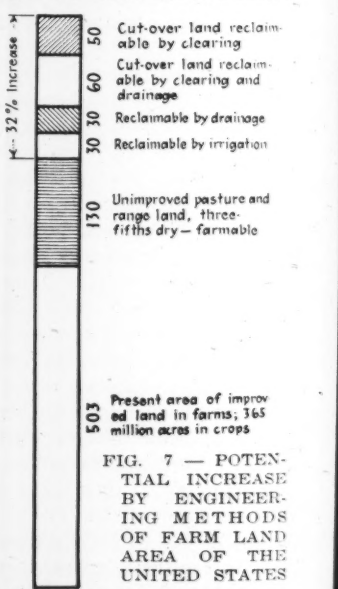


FIG. 7 — POTENTIAL INCREASE BY ENGINEERING METHODS OF FARM LAND AREA OF THE UNITED STATES

Another significant activity that augurs well for the future is the co-operative project launched about two years ago by the National Electric Light Association, The American Society of Agricultural Engineers, and various power companies and individual farmers in many states. Briefly, the purpose of this investigation is to discover ways and means of increasing the electric power consumption of individual farms to the point where it will become profitable for central stations to supply them with high-line current. In a study of this kind, the trained agricultural engineer is obviously indispensable.

The consulting field in agricultural engineering is as yet scarcely touched. There are a few engineers, however, who have enjoyed a lucrative practice in this field for some years. Their clients usually are wealthy owners of rural estates and holding companies engaging in agricultural operations on a large scale. On the whole, there is ample reason to believe that agricultural engineers will continue to perform ever more valuable service and that they will continue to grow in the respect of their colleagues and of the public.

ACTIVITIES OF AGRICULTURAL ENGINEERING GRADUATES

Institution	Number of Graduates	Deceased	Education and Research	Farm Equipment Industry	Farm Structures	Land Reclamation	Farming	Miscellaneous
A. & M. College of Texas	16	0	1	3	..	2	..	10
Oklahoma A. & M. College	2	0	2	..	..	..	..	..
Va. Polytechnic Institute	13[1]	0	6	2	1	..	1	3
Kansas State Ag. College	28[2]	0	11	6	1	3	3	4
University of Nebraska	42	0	13	8	2	2	11	7
Iowa State College	157	8	62	19	10	13	25	21
University of Missouri	4[3]	0	2	1	1	..	..	..
University of Saskatchewan	6	0	3	..	..	..	..	3
Totals	268	8	100	39	15	20	43	45
Percentage	100	2.9	37.2	14.4	5.5	7.4	16	16.6

1. Does not include 12 graduates in 1924-25. 2. Includes 3 men with A. E. degree. 3. Includes 1 man with B. S. in Ag. degree.

Skew Arches Investigated by Means of Hard-Rubber Models

EXPERIMENTAL study of skew arches is in progress in the laboratory of Prof. George E. Beggs at Princeton University, Princeton, N. J., for the committee on concrete and reinforced concrete arches of the American Society of Civil Engineers. An interesting test arrangement and method is used. The test arches are made of hard vulcanized rubber, and their strain relations are being studied by an effectively planned application of the principle of virtual displacement. In its general nature, the experimental arrangement is a close analogue to Professor Beggs' "Deformeter," used for investigating continuous structures by means of plane models. The skew arches under test have a span of about 20 in. and a rise of 8 in., and in dimensioning are precisely similar to the skew arches tested by the Bureau of Public Roads at Washington on 7-ft. spans; skews of 30 deg., 45 deg. and 60 deg. are represented.

The test arch is set upon two bed plates or abutment plates mounted on a very heavy and rigid structural steel supporting frame. The one abutment plate is fixed to this frame, while the other is supported by six adjustable rods (arranged to apply the six reaction components required for equilibrium), each of which has two short, flexible sections of $\frac{1}{8}$-in. diameter to enable it to act as a frictionless rocker support. In each of these rockers is a turnbuckle adjustment, so that by suitable manipulation of these turnbuckles it is possible to shift the abutment sideways, toward or away from the other abutment, or vertically up or down, or to rotate it in one of the three moment planes. The motion of the abutment with reference to the fixed abutment is measured by dial gages, giving readings to 0.001 in. Seated vertically on the top surface of the arch at 55 co-ordinate points are light vertical rods bearing against similar dial gages at their upper ends and footing on the arch by means of steel pins (phonograph needles) set in shallow pits in the outer surface of the arch.

To investigate the strain relations of the arch, these extrados dials are first set to zero reading; then a determinate movement of a few hundredths of an inch is given to the movable abutment, or a corresponding rotation; then the extrados dials are again read. Their readings represent the vertical displacement of the arch caused by the applied movement of the abutment, or, in other words, the effective leverage of the arch structure between the abutment and the particular point at which the reading is taken. The same ratios, then (by virtue of the well-known reciprocal theorem), represent the force ratio between a vertical load applied to the arch at the point considered and the abutment reaction in the direction of the movement applied in the experiment. Thus, in a few "runs" it is possible to obtain complete sets of influence values for the arch reactions. Completion and discussion of the results will probably take several months, and in the meantime an analytical study is being carried out for comparison with the experimental results, with a view to determining the applicability and limit of precision of the theory.

New South American Transcontinental Railway

Renewal of work on the new Argentine-Chilean transcontinental line, headed for the Pacific port of Antofagasta, is reported as probable under the new Argentine government, which is favorable to railway development. The construction of the Argentine portion of the line, in which much American machinery and equipment was used, was described in *Engineering News-Record* of Aug. 30, 1923. Soon after that time, political changes and the impossibility of getting the Argentine Congress to take any action or to vote funds, caused first a reduction and eventually almost complete stoppage of work. For some time the rail-head has remained at Puerta de Tastil and the only work of importance done since then has been the completion of all tunnel work as far as the Abra de Chorrillos. Grading is ready for some 80 miles ahead of the present rail-head and there has been finished a little more than 70 per cent of the work, as regards cost. The amount of heavy grading, tunnel and viaduct work to be completed is small, although the heaviest bridge on the line is yet to be constructed. this is the Munal viaduct, 787 ft. long and 246 ft. high. The Chilean government has approved the Barros-Jarpa Noel treaty which assures the initiation of the work on their section as soon as this treaty is ratified by the Argentine government.

Concrete Bridge Designed for Elastic Movement

Swedish Railroad Bridge in Cold Climate Uses Steel Hinges, Different Concrete Mixes, Large Expansion Joints, and Expansion Slide Plates Under the Floor

By Charles R. King
Member, Institution of Civil Engineers, London, England

THE PECULIARITY of the reinforced-concrete railway bridge of the Swedish State Railways which crosses the River Ore about 85 miles northwest of Stockholm near the town of Krylbo, consists in the mechanical jointing together of eight separate monolithic sections, Fig. 1, each subdivision being further designed to permit in itself elastic movements under temperature variations and loads. All the transverse gaps in the structure for permitting elastic movement in vertical and horizontal directions were made watertight by a system of layers of lap-jointing, which is in turn covered with pliable materials, the whole resembling fish scales. Besides the mechanical jointing in the sections composing the bridge, the concrete itself is constituted of a mosaic of different strengths, in order to resist or to yield, according to the local needs. The various proportions, the locations of which are indicated on Fig. 3, were determined by an elaborate series of tests made in connection with the design.

Durability under severe conditions of climate and rolling loads is the main purpose of such refinement in construction. The bridge is located at 60 deg. north latitude, and subject, therefore, to a very wide range of temperatures. The main arch span is about 295 ft., and the whole bridge is built on a grade of 1.1 per cent. A

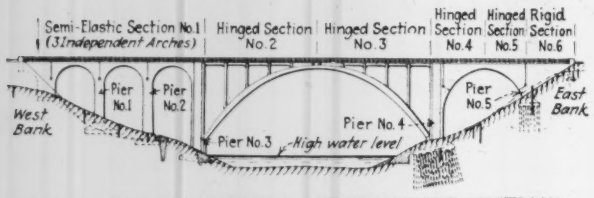


FIG. 1—SKETCH SHOWING INDEPENDENT SECTIONS OF BRIDGE

large amount of centering was necessary as shown in Fig. 2, this falsework, in fact, costing nearly three times as much as the arch itself.

The bridge was designed by Prof. Otto Linton, of the University of Stockholm under the general conditions drawn up by the director of roads and waterways, Rolf Moberg. The construction work was carried out by the engineering firm of Kreuger & Linton.

Foundations and Piers—The two piers on the east bank of the river are supported on a concrete pile foundation. Wooden piles were used under the river abutments supporting the falsework.

The concrete cap on top of the piles for the east bank river pier No. 4 measures about 60x55 ft. and stands with a slope of 1:6.8 from the horizontal line as planned with regard to the thrust from the main arch ring. The reinforcement in this cap consists of a crossed steel-rail mat on the bottom and 1-in. round bars set at an angle of 45 deg. in both the longitudinal and transverse directions in the main body of the cap. This detail, as well as others hereinafter referred to, is shown in Fig. 3.

The east bank piers are made hollow, are heavily reinforced, and are braced at various heights by transverse beams of reinforced concrete with their ends carried in wall mortises. The approach bridge walls on the east bank are also braced by three full height transversing walls.

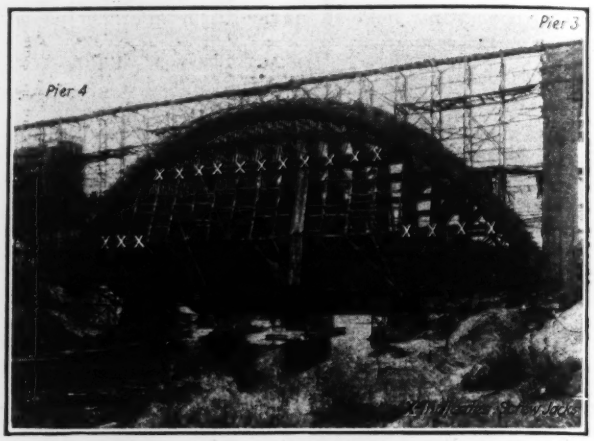


FIG. 2—MAIN ARCH CENTERING UNDER FULL LOAD OF CONCRETED ARCH
The falsework cost nearly 3 times as much as the arch itself.

The west bank piers are carried on natural foundations. In the top of each of these piers is placed a 20-in. expansion gap 24 ft. deep, shown in Fig. 3.

Steel Hinges—The two largest arches in the structure are supported by six transverse rows of steel hinges. There are five hinges in each abutment course, each set held together by a steel pin, 3½ in. in diameter with a total bearing length of about 23 ft. 3 in. The halves of each hinge are similar, and are held together by their own weight, with a slight space between their knuckles to permit a small radius of rotation about the pin. This space is filled with natural tar for waterproofing.

The steel hinges are connected to the ordinary steel reinforcement by means of spiral reinforcement having coned diameters. There are nine spiral reinforcements to every five hinges in each main arch abutment; each crown hinge has eight spirals as shown in the detail in Fig. 3 and also in Fig. 4. The smaller arch, about 106 ft. in span, is similarly hinged but with smaller fittings.

To make the line of hinges on the main arch abutment waterproof, particularly from snow and rain draining down the arch extrados, the foot of the arch ring terminates with a concrete spur which projects into a niche in the pier wall. This leaves a joint which is filled with a plastic waterproof material.

Floor Slides—The bridge floor is rigidly attached only at the crown of the main arch, so that its two ends are free to move longitudinally on the main pier abutments under the guidance of steel expansion slides shown in detail in Fig. 3. The floor consists of four stringer beams and a trough of concrete filled with ballast to carry the railroad track. Under each beam is the ex-

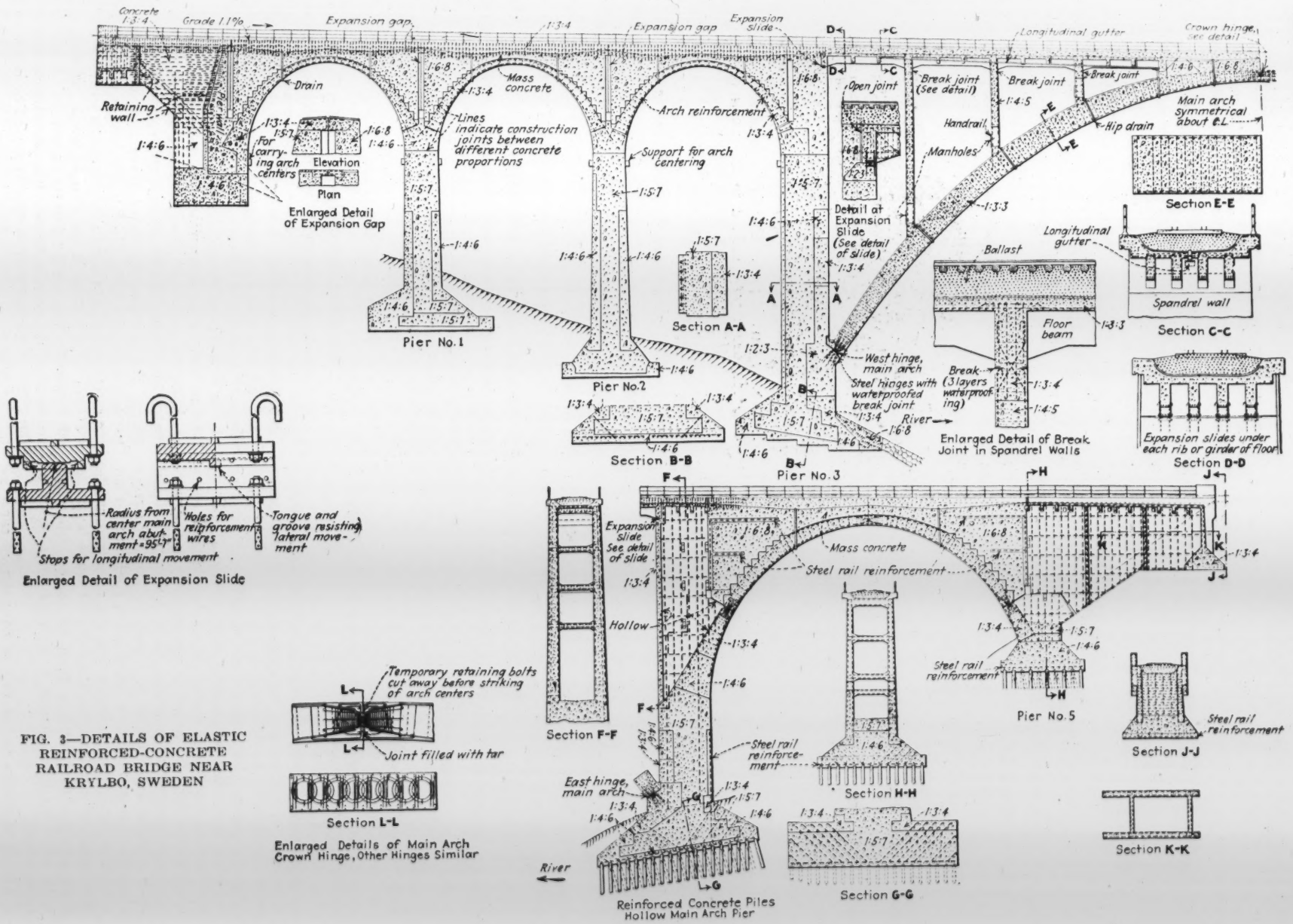


FIG. 3—DETAILS OF ELASTIC REINFORCED-CONCRETE RAILROAD BRIDGE NEAR KRYLBO, SWEDEN

pansion slide consisting of a fixed plate that slides on a railhead 19½ in. long aligned crosswise to the direction of the floorbeam. The upper surface of this railhead is rounded so that the plate above it rests on less than 2 in. of surface. The bridge floor is thus free to deflect vertically from that point in accordance with the floor swing through a radius of 95 ft. 7 in. as struck from the center of the main arch abutment hinge. Beyond the limits of all possible longitudinal movements, there are stops on the upper bracket. Also, all lateral mavement is made impossible by cutting a slot through the middle of each supporting rail, into which engages a tongue cast in the center of the upper bracket.

The spandrel walls were also designed to permit free expansion movement of the floor. This object was attained by inserting break joints consisting of three different sized layers of waterproofing cutting into the walls by one-third of the thickness from each side as shown in detail in Fig. 3. In this detail, it is also noted that the reinforcement is crossed diagonally in an X-form.

This arrangement of steel is designed to permit a semi-pivotal movement in the surrounding concrete. The shortest spandrel wall nearest the arch center is provided at top and bottom with two breaks in continuity, but the other two deeper walls have such joints

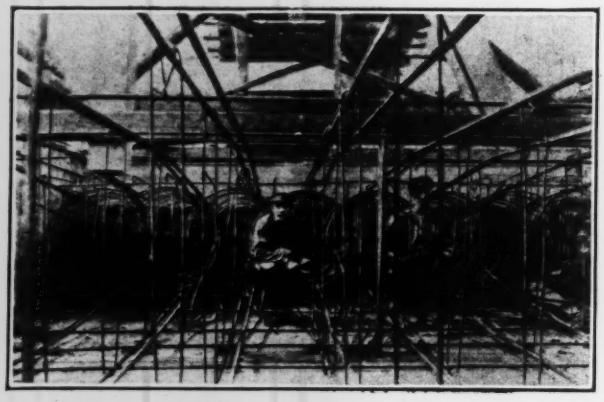


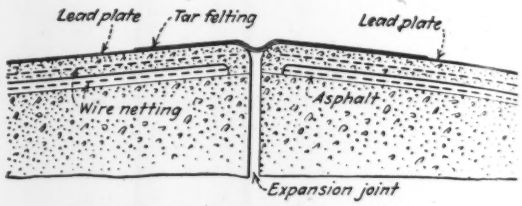
FIG. 4—SPIRAL REINFORCEMENT AT BACK OF STEEL HINGES IN THE ARCH CROWN

only below the floor level, because the relative thinness of these latter walls, considered with regard to their height, was estimated to contribute to the necessary swinging movement.

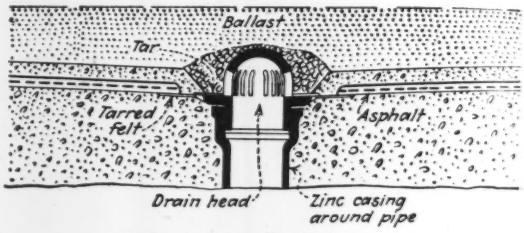
Drainage and Waterproofing—Much care was exercised in the design of drainage and waterproofing details in the structure because of the several large openings used in its design.

Transversely, the bridge floor is of trough section draining towards the middle and longitudinally is divided into a series of cants. The ridge on these cants corresponds with the break in the concrete for permitting temperature movements. This is shown in detail in the upper part of Fig. 5. Here the mass concrete was first covered with a layer of asphalt, and then a layer or cap of 1:3 concrete was run on a wire mesh. The break, or vertical gap, through the three layers is then covered, first with a sheet of tarred felt, then with sheet lead and finally is covered by a sheet of tarred felt.

The floor drains in the valleys have domed caps the flanges of which are seated in tar on layers of tarred felting that extend upward under the sheet of pliable tar which latter is covered by the cap of 1:3 concrete.



Protections against Water Percolation Through Expansion Joints



Drainage of Floor

FIG. 5—WATERPROOFING AND DRAINAGE DETAILS

See lower part Fig. 5. The drain head sockets into a cast-iron drain pipe bedded in the mass concrete of the floor, but it is cased externally with zinc sheeting to waterproof the concrete. The outlet pipe drains into a pressed metal gutter, shown longitudinally in Fig. 3. The arch ring abutments are drained from their sides, as the hinges placed there require special precautions. The smaller hinged arch is drained direct from the floor above, which in this case forms part of the arch. The hollow piers, 4 and 5, have drain courses at their deepest levels in case sleet or snow enter by the ventilation holes and tend to cause corrosion.

The arches on the west bank form part of the floor and are drained direct through from the ballast. The deep expansion gaps, which run down to the level of the springing of each western arch, are provided with drain courses and outfall pipes at their deepest level. The floor surface above these gaps is filled with natural tar for waterproofing.

Ohio River Regulation at Evansville

The Chief of Engineers has recommended a modification of the existing project for the improvement of the Ohio River, to protect a bend known as the Kentucky Peninsula and hold the channel of the river as it passes Evansville, Ind. This work involves the reforestation of the sloughs on the Kentucky Peninsula and on the bank as well as the bank protection, at an estimated cost of $200,000, provided local interests furnish without cost to the United States all land necessary for the purpose. The District Engineer fears that unless such work is done, the Ohio River in flood stage may cut its channels through the Kentucky Peninsula some six miles distant. This change in the channel would not only cut off Evansville but would probably materially change the sediment of the stream below. The recommendation by the Chief of Engineers has been approved by the Secretary of War.

Crossing Elimination and Road Relocation in California

Examples Selected from Recent Operations Indicate Methods Followed and Costs Involved

Removal of grade crossings and line improvement to avoid crossings has in California in common with other large road building states involved in recent years a number of major highway construction operations. From information got from the state highway commission a number of these operations are outlined here. They are of enough variety to indicate practices, though no attempt is made completely to catalog the work done or contemplated. Examples of elimination both by separating grades and by relocating to avoid crossings are included. In several instances some account of the economics and cost of the improvement has been possible.—EDITOR.

SINCE 1924 there have been completed or put under construction on California state highways 14 grade crossing eliminations costing about three-quarters of a million dollars. There are now planned for early elimination six major crossings. These are but a fraction of all crossings. In 1922 the state highway commission in conjunction with the Bureau of Public Roads and the State Railroad Commission made a study of grade crossings on state highways. A total of 573 crossings were investigated, 446 of which were outside the corporate limits of cities and the remaining 127 within the limits of cities but on state highway routes. A classification of these crossings was made as follows:

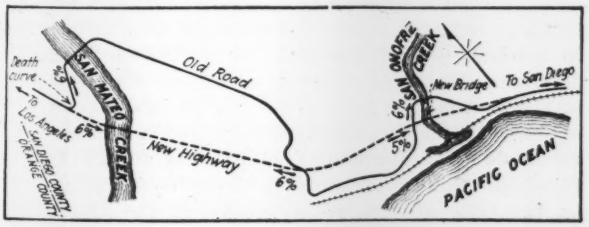


FIG. 2—RELOCATION CUTS OUT SIXTEEN CURVES

Class I—Crossings possible of elimination by relocation. (This number is indefinite.)

Class II—Crossings of a primary highway and trunk line railway of two or more tracks, 24.

Class III—(a) Crossings of a single-track line and a primary or trunk highway or of any trunk line and secondary highway, 71; (b) crossings of a single-track line carrying a moderate traffic (not a transcontinental road) and a primary trunk or secondary lateral. Includes important suburban electric railroads, 58.

Class IV—(a) Crossings of unimportant single track steam or electric lines on which service is limited and primary trunk or secondary lateral highways, 124; (b) crossings of spur and switch lines with all highways, 114.

This classification it will be observed gives primary place to crossing elimination by highway relocation. One of the examples of relocation given indicates the possibilities where the occasion presents itself. However, relocation is a broader problem, usually, in which crossing elimination is one factor. The examples here given are presented in this broader aspect. The common crossing elimination involves grade separation and not relocation to avoid crossings.

Grade Separations—Of the 14 crossing eliminations previously mentioned two only were line relocations; three were overhead bridges and nine were subways. Fig. 3 illustrates and describes several of these crossings. The most expensive was that at Montebello in Los Angeles County, costing $200,000. Of seven proposed eliminations that are planned for the near future, one is an overhead crossing and six are subways. Of the latter, the most notable is the South San Francisco underpass, estimated to cost $250,000, described in *Engineering News-Record*, Nov. 12, 1925, p. 815. In respect to grade separation, the cost is usually borne jointly by the railroad company and the state, but counties and other political subdivisions often are willing to participate. Division of cost among the various participating bodies is affected by features pertinent to particular crossings and frequently is agreed to in advance, but in some instances it is necessary to have the State Railroad Commission determine the matter. In all instances official authorization for the project must come from the railroad commission.

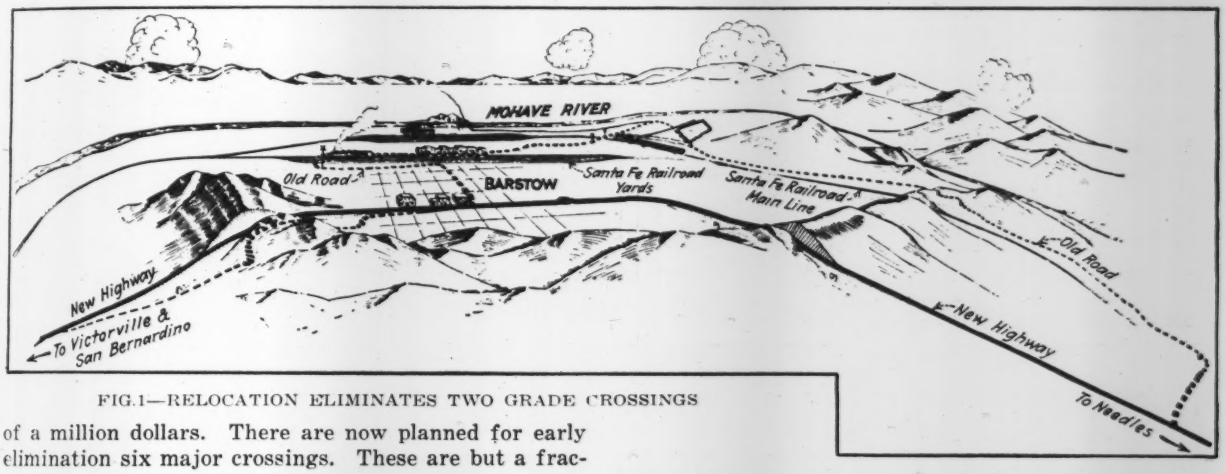


FIG. 1—RELOCATION ELIMINATES TWO GRADE CROSSINGS

The design of structures for grade separations is a duty of the bridge department of the highway commission. The plans, of course, have to meet with the approval of railroad engineers and the railroad commission. Generally the work is done by the state, but sometimes the railroad company desires to construct a portion of a subway or superstructure. Construction by railroad forces does not mean that the work is being done solely at the expense of the railroad. It means, merely, that a co-operative agreement has been reached

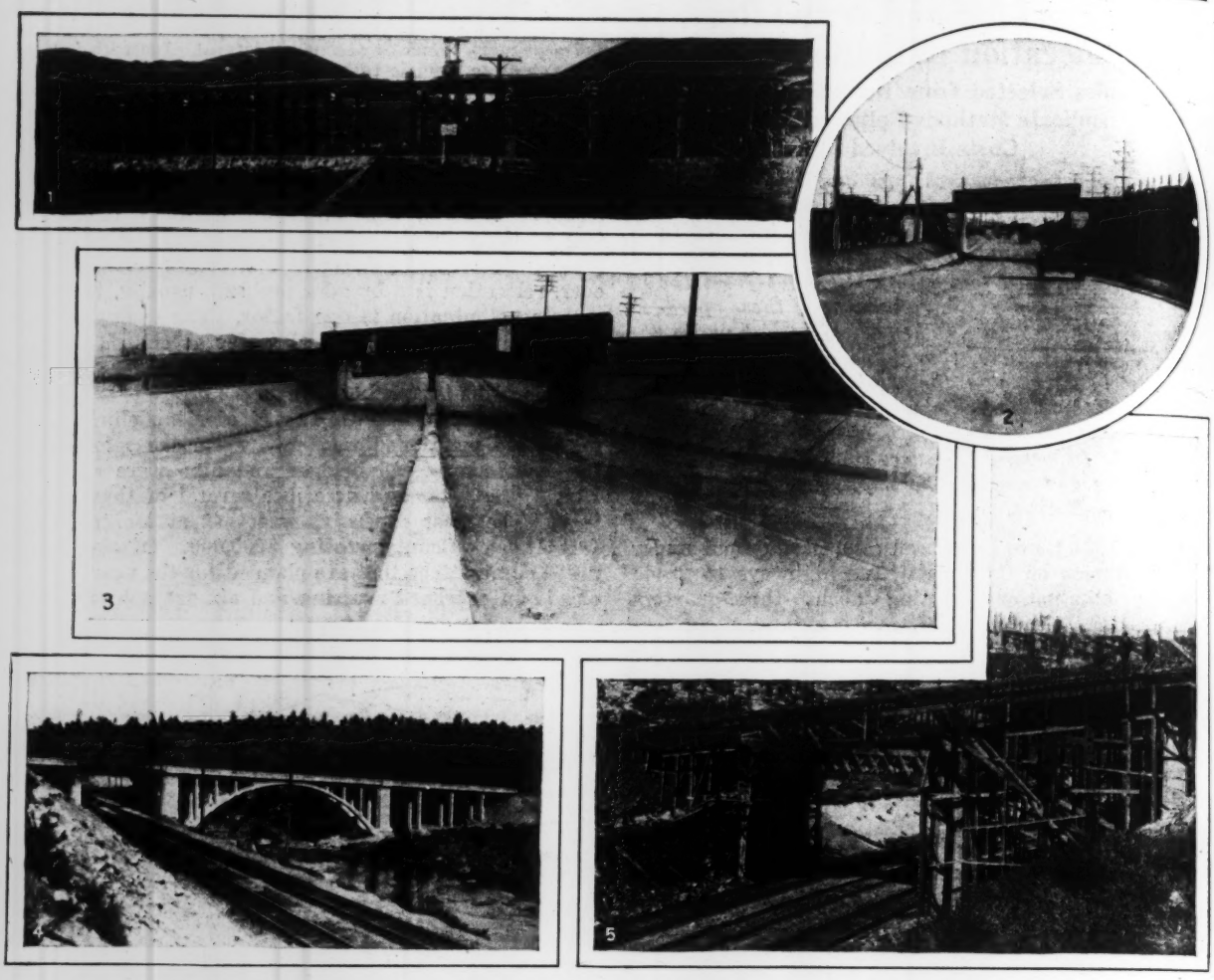


FIG. 3—TYPES OF GRADE SEPARATIONS ON CALIFORNIA STATE HIGHWAYS

1. Pismo, San Luis Obispo County—Overhead structure of reinforced concrete girder type over tracks of Southern Pacific; J. L. Webster, contractor; estimated cost $60,000. Part of important realignment project.
2. North Sacramento, Sacramento County—Subways under the tracks of the Western Pacific and Sacramento Northern railways made possible the removal of a dilapidated wooden trestle which crossed the railroad lines at grade. Lord Bishop, contractors; cost $59,000; completed in January, 1926.
3. Montebello, Los Angeles County—Largest subway on state highway system, located south of Montebello on Los Angeles-Whittier highway, one of the heaviest traveled state highways. Original narrow highway, crossing tracks of Los Angeles and Salt Lake Ry. (Union Pacific System) at grade, has been widened to 56 ft. and a modern structure built to eliminate the grade crossing. The subway has two one-way openings, each with 28-ft. clear width, dividing traffic into three lines each way. Subway was built by the railroad company, the highway commission co-operating at a cost of $200,000. Completed March, 1926.
4. Polaris, Nevada County—Crossing of two main line tracks of the Southern Pacific Co. and Truckee River was affected with one structure, an arch spanning the river, the tracks passing under the girder approach span. Proctor & Cleghorn, contractors, cost $53,000; completed October, 1925.
5. Hinton, Nevada County—Overhead structure in the Truckee River highway, crossing the tracks of Southern Pacific. T. H. and M. C. Polk, contractors; estimated cost $30,000.

for the work to be done by construction forces of the lines. The railroad commission as a general rule assesses at least 50 per cent of the cost of all grade separations to the public.

Road Relocation—As an example of highway relocation primarily to eliminate grade crossings, the new line of the National Old Trails route through Barstow as shown by Fig. 1 is notable. The old county road, shown in the illustration, followed a tortuous course through the town, crossing the main line of the Santa Fé railroad twice and passing through its freight yards. It had many right-angle turns and the view at two of the crossings was obstructed. Accidents were frequent. The grading of less than three miles of the state highway shortened the distance 1½ miles and eliminated the three railroad crossings.

For gains purely by curve elimination the relocation shown by Fig. 2 is selected. Here a relocation only two-thirds of a mile long cut out 16 curves. The new location required the construction of two bridges but in building these it was possible to provide for future traffic requirements to such advantage that this part of the cost cannot be charged wholly against the relocation. The old location involved three curves on which accidents were frequent and ofttimes fatal. Two of these curves were at the foot of 6 per cent grades and on the edge of streams as shown in the illustration. Although bad accidents have occurred at all of these curves there were so many more fatal accidents at the very sharp curves at the extreme left that this came to be known as "Death Curve."

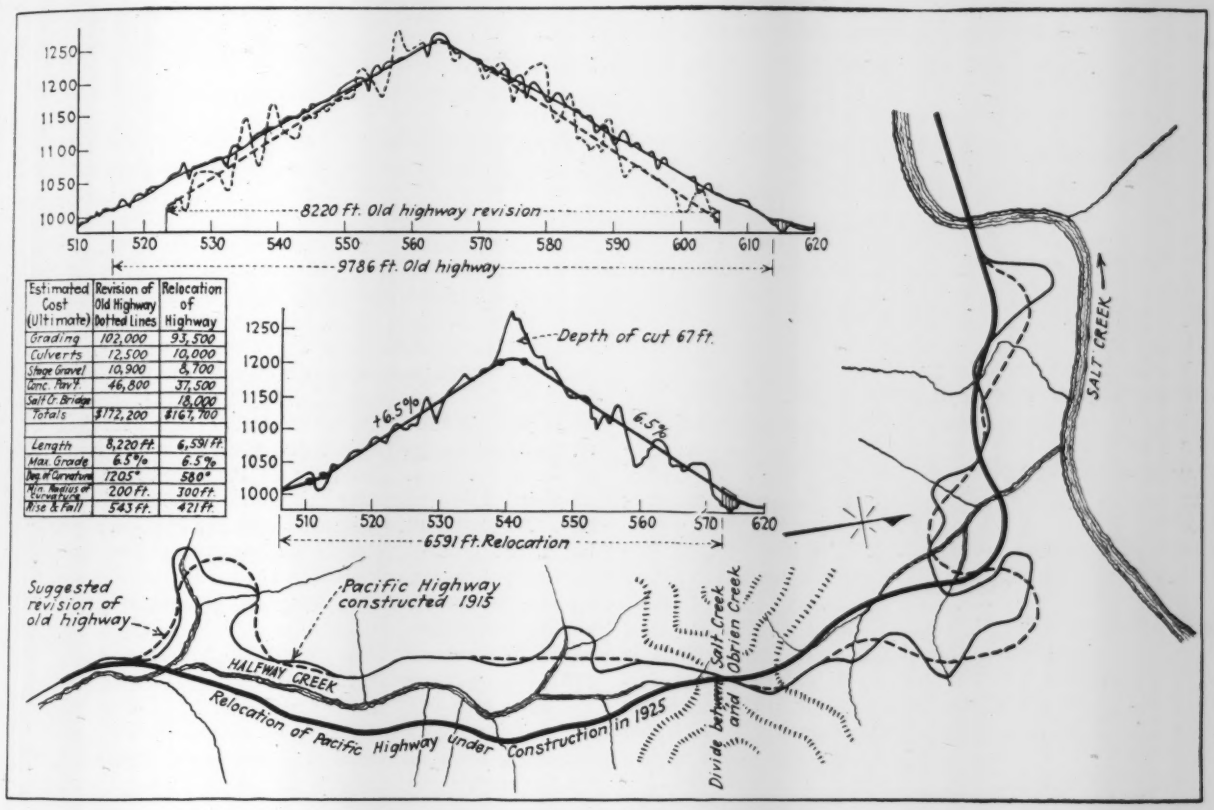
Relocation from the point of view of traffic economies is represented by the new line of the Pacific Highway through Sacramento Canyon. An account of this project as given by H. S. Comly, division engineer, Redding, Calif., is as follows:

The original construction of the Pacific Highway between Redding and Dunsmuir in Shasta County was in 1915. In accordance with the situation then existing, engineers of the department were instructed, if possible, to build a road through the Sacramento Canyon at an expenditure of $4,000 per mile. It became apparent as soon as surveys were under way that this could not be done, and, after the work was completed to the lowest standard which would come within the meaning of the word "highway," a 17-ft. graded road had cost an average of $10,000 per mile. The grading was done between the years 1914 and 1917, and represents the 1915 standard of California mountain road construction.

In 1923, when the commission decided to complete the main trunk lines and interstate connections, it became apparent at once, because of the fact that the traffic had increased so rapidly during the previous eight years, that the Sacramento Canyon section of the Pacific Highway had been built on too low a standard. Placing of pavement on the crooked, narrow grade could not be considered. Decision was made for a bold relocation on standards which would fufill the demands of present and future traffic.

Surveys for reconstruction of the sixty-five miles of highway grade between Redding and Dunsmuir were started late in 1923. Construction work began in January, 1924. In 1925, 34 miles of old line had been reconstructed. On this portion, the distance has been shortened three miles, the new highway measuring only 31 miles. A location survey for the remainder of the canyon section is finished and shows a total saving of 6.5 miles. When the reconstruction is completed, the distance from Redding to Dunsmuir will be reduced from 65 to 58.5 miles, or 10 per cent.

Assuming the average cost of operating a motor vehicle to be 7½c. per mile, the shortening of distance will save every vehicle traversing this section of highway about 50c. per trip. Traffic now averages, throughout the year, about 1,000 vehicles a day and the saving is $500 a day or about $183,000 a year. Capitalized at 5 per cent, the saving in distance alone would warrant the expenditure of $3,660,000. The cost of construction, including bridging, will be about $2,750,000. Therefore the reconstruction more than pays for itself by the factor of distance saving alone, based on present traffic. The distance to be paved will be about 56 miles, and this will cost approximately $2,000,000. The shortening of distance will not only pay for the reconstruction but also a large part of the paving bill.



Estimated Cost (Ultimate)	Revision of Old Highway Dotted Lines	Relocation of Highway
Grading	102,000	93,500
Culverts	12,500	10,000
Stage Gravel	10,900	8,700
Conc. Pav't.	46,800	37,500
Salt Cr. Bridge		18,000
Totals	$172,200	$167,700
Length	8,220 Ft.	6,591 Ft.
Max. Grade	6.5%	6.5%
Deg. of Curvature	12.05°	5.80°
Min. Radius of Curvature	200 Ft.	300 Ft.
Rise & Fall	543 Ft.	421 Ft.

FIG. 4—RELOCATION REDUCES DISTANCE AND CURVATURE OVER 30 PER CENT

Saving of distance is by no means the only important feature of this work. If it were possible to capitalize the improvement in width, alignment and grade, the figures would be even more surprising. The width of the completed roadway, including drainage ditches, will be 27 ft. on sidehill construction and 30 ft. where the construction is not so heavy, as compared with 17 ft. on the old grade.

The minimum radius of curvature will be 300 ft., as against 50 ft. on the original highway. The number

These figures are rather startling in view of the fact that they are based only on present day traffic. It may be conservatively estimated that traffic will more than double during the next five years, by which time it is hoped the paving will be completed.

of curves will be reduced more than one-half. While the maximum grade will still be 6½ per cent, several miles of maximum grade will be entirely eliminated, and many more will be reduced to 4 per cent or less. The total ascent and descent will be greatly reduced by this means.

What advantage this means in increased speed, coupled with increased comfort and safety of traffic, in accidents prevented and lives saved, can not be estimated in dollars and cents; the advantage can not be denied, however.

In planning the reconstruction through the Sacramento Canyon, exhaustive investigations were made to insure attainment of the most satisfactory results. Various possible solutions of each problem were considered, preliminary lines run, projections made and comparisons of cost studied. These investigations and the final location, including plans, cost, on the average, $1,250 per mile, or 2½ per cent of the cost of the work. While it is not possible to arrive at an exact saving by reason of the excess preliminary cost, it is probable an expenditure of $500 per mile, over the minimum cost of surveys and plans, is saving not less than $2,500 per mile in construction. Besides this actual saving the most perfect final location consistent with the standards adopted has been arrived at and there is assurance that the alignment and grades are the best that can be worked out.

While a considerable part of the improvement is brought about by widening the existing roadbed and flattening or eliminating curves, there are many instances where a complete abandonment of the old highway has proved advisable and economical. A typical instance of this is illustrated by the accompanying sketch, Fig. 4, of the relocation over the Salt Creek divide, now under construction. As indicated in the tabulation accompanying the map, the ultimate cost of the improvement by complete relocation is less than by a simple line revision and widening of the existing highway, as indicated by the dashed lines. This is true despite the fact that a concrete bridge across Salt Creek has to be demolished and a larger one on a higher grade line built in its place. The relocation necessitated an 81-ft. cut at the summit, containing about 80,000 cu.yd. of excavation.

It also will be noted the use of curves of 300-ft. radius was not possible along the old highway, and that the line revision included two bad loops made up of curves of 200-ft. radius. The relocation has only two curves of less than 500-ft. radius, one of 300-ft. radius and another of 325 ft. The total curvature is reduced from 1,205 deg. by line revision, to 580 deg. by relocation. It will also be noted the relocation is 1,629 ft. shorter than the line revision in a distance of a mile and a half.

Compared to the highway of 1915, the relocation saves 0.6 mile in a distance of 1.9 miles, and reduces the number of curves from forty to fourteen. The improvement in width is denoted on the sketch which shows the relative width by exact scale. The rise and fall is reduced by 130 ft., and the length of maximum grade by about one-half mile.

Direction—The work described has been performed under the direction of the California Highway Commission, R. M. Morton, state highway engineer.

A.A.E. Convention Reveals Sound Internal Condition

Membership and Finances Again in Satisfactory Shape—Association Will Publish a Professional Manual

SATISFACTORY internal and administrative conditions were brought to light at the twelfth national convention of the American Association of Engineers, held last week at Philadelphia. Disagreement over internal policies has marked the conventions for several years past, but on this occasion it was quite absent, and at the same time the reports of the officials showed a stable condition of membership and finances—equally in contrast with conditions that had prevailed for several years.

Steps were taken to develop the work of the association in several important respects. A plan was adopted for publishing a professional manual of engineering. Special publications are also to be put out covering the rules of practice and decisions in practice cases worked out by the association. A service pledge was adopted. Life membership was instituted by the directors, and it was decided to create a permanent fund, to be built up by setting aside monthly 5 per cent of the association's income. The intention was expressed to develop further the association's employment service, though for the present no new offices (the two now existing are in New York and Chicago) will be created.

At present the total membership of the association is about 6,900, composed of 5,300 adult members and 1,600 student members. This figure represents an increase of about 1,200 over the minimum, reached six months ago. As membership records now are kept on a paid-up basis, the present total is believed to be free from inflation by overdue expirations. Equal improvement is shown in the finances. Careful management of the association's money affairs resulted in a gain of surplus of $7,500, as against a loss of $6,200 in the previous year, in the face of a reduced income.

Publication of *The Professional Engineer* practically covered its cost (with a fixed allotment from dues to cover subscription charge). The same is true of the employment service, which placed about 500 men in the 12 months.

Committee Reports—Arthur C. Richards presented, for the committee on services and salaries of engineers in public service, an encyclopedic review of cost of living, income and classification of services of engineering officials of cities, counties, states and the government. The report was presented only in brief abstract. A coordinate report was rendered on the subject of services and fees for practicing engineers by Paul Hansen. This presented a curve of proposed percentage fees recommended as minima, for work costing less than $1,000,000; it ranges from a maximum of 6 per cent for a $10,000 undertaking to 3½ per cent for $1,000,000, when design specifications and construction supervision are included; and from 4 per cent down to ¾ per cent for preliminary investigations and reports.

Reporting for the committee on permissible free public service, Victor H. Cochrane recommended that the association or its chapters should not undertake public service when the required work consists of development

of details and does not involve skilled professional opinion; when the required time and labor are such as to constitute a hardship upon those who would undertake the work; and when there are no individuals in the group having the specialized knowledge and skill for carrying out the service effectively.

The problem of engineering competitions was brought to the front by the report of the practice committee, which during the year considered one case of this kind. It suggested that the association draft a code to govern the conduct of engineering design competitions similar to the corresponding architectural codes.

Registration of engineers was less actively dealt with during the past year than previously. The committee on registration reported various local criticisms of registration laws. The report and the discussion bore particularly on the Pennsylvania law, which it was charged is badly administered; it is now before the court for a determination of its constitutionality, with a lower court decision against it.

Considerable active discussion on various questions concerning registration developed after reading of the report. O. Laurgaard, city engineer of Portland and chairman of the Oregon Board of Engineering Examiners, described the successive improvements of the Oregon registration law by amendment, and said that the state is now in a position to investigate violations and to use registration funds for prosecution of violators. He suggested making registration a condition of membership in engineering societies or in the association chapters, as has already been done in the charter of the new Portland Chapter of the association. The formation of societies of professional engineers is an undesirable development, he declared. Arthur C. Richards, of Altoona, referred to the fact that 25,000 engineers are now registered in the 27 states having registration laws, against a total membership in the four principal technical societies and the association of about 40,000, and a census enumeration of about 90,000 engineers. This slowness of development of the registration movement, and conditions arising from the grandfather clause, which were criticised by some members, are outweighed by the fact, Mr. Laurgaard stated, that through registration laws we are building the engineering profession of the future. Later the convention passed a resolution in favor of energetic continuance of the campaign for registration laws and their improvement.

A plan developed during the past year for the preparation of a professional manual of engineering was endorsed and adopted by the Board of Directors and by the convention. This manual is intended to assist business men, public officials, and the general public to a better understanding of the professional phase of engineering work and the reasons for professional standards, codes of ethics, practice rules, and fixed fees.

Organizational Affairs—It was decided to award a gold medal annually for the most significant achievement in welfare work during the year. The committee on award is to consist of two members of the association and three prominent engineers selected without regard to association membership.

The following service pledge was selected by the Board of Directors from among a number prepared by various members during the past year, the adopted draft being that of retiring president D. B. Steinman:

We dedicate ourselves to the service of mankind as members of the engineering profession.

We consecrate our professional knowledge and skill to the advancement of human welfare, safety, and progress.

As we benefit by the technical knowledge and public esteem won for the profession by the engineers who labored in the past, we shall ever strive to augment that heritage before passing it on to the engineers who are to follow.

We therefore affirm our guiding purpose:

So to live and work as to justify the trust and confidence reposed in the engineering profession.

To carry out professional engagements with generous measure of performance, and with fidelity toward those whom we understand to serve.

To foster a spirit of courteous consideration and fraternal co-operation within the profession.

To extend encouragement and a helping hand to younger engineers and to those in need.

To place service before profit, the honor and standing of the profession before personal advantage, and the public welfare above all other considerations.

Two minor changes in administrative system were instituted. The convention decided to elect each year a nominating committee, instead of leaving nominations for officers to the membership and to the directors. It adopted a slightly modified form of offering and voting amendments to constitution and by-laws.

Election of officers for the coming year resulted in the choice of C. J. Ullrich, of the engineering firm of McGonagle & Ullrich, Salt Lake City, as president, over George E. Taylor of West Virginia. W. R. Harris, of Cleveland, won in the contest for first vice-president, and Donald M. Baker, of Los Angeles, for second vice-president. The newly elected directors are: J. M. Buswell, C. W. Cross, V. H. Cochrane, C. S. McKee, H. G. Culverhouse, E. G. Haines, and J. Denison. The convention voted in favor of Tulsa, Okla., as the seat of the 1927 convention.

Addresses—Of a number of addresses of general interest that were a feature of the convention, the following may be noted. Mrs. L. M. Gilbreth, of Montclair, N. J., dealt with the subject of motion study as related to fatigue and other factors of efficiency. C. E. Chase, of Philadelphia, briefly outlined the principal elements of the new Delaware River bridge. Prof. D. S. Robbins, of Las Cruces, N. M., spoke on "New Scientific Knowledge of Interest to Engineers." Dr. Frederick H. Newell, of Washington, reviewed the history and progress of the association, while Morris L. Cooke, of Philadelphia, discussed the subject of "Giant Power." Visits to the Philadelphia subway construction work and other engineering and historical points of interest at Philadelphia, as well as trips to Atlantic City and to New York, including Coney Island, furnished entertainment and diversification.

President's Address—Dr. D. B. Steinman, retiring president, addressed the association on the subject, "Our Profession." His scholarly discussion of the subject dealt with the obligations to mankind and to the future which form the basis of engineering ideals. Developing this theme further, he indicated how the original purposes and the work of the association have been directed toward advancing these ideals and serving the profession and public.

[*Abstracts from the Address of Dr. Steinman will be published in an early issue.*—EDITOR.]

From Job and Office

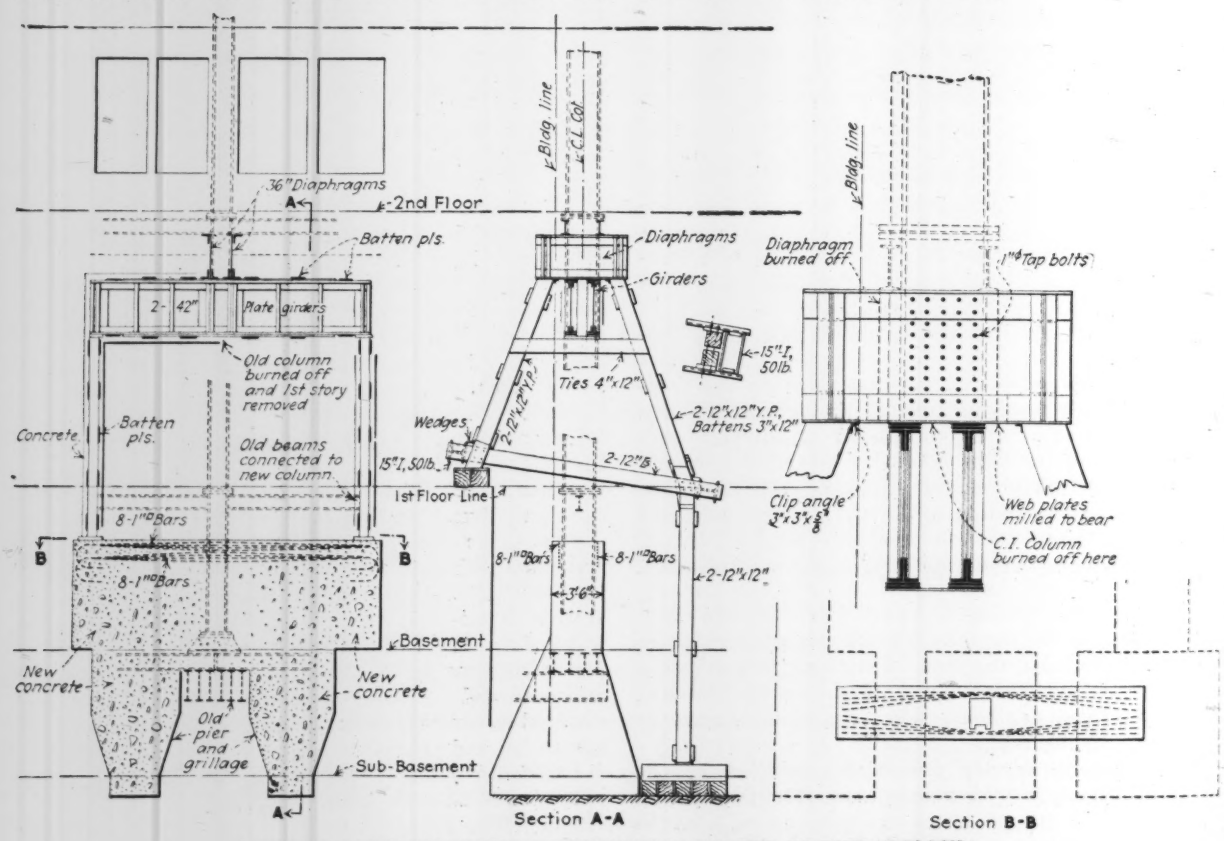
Hints That Cut Cost and Time For the Contractor and the Engineer

Remove Cast-Iron Column Carrying Ten Stories

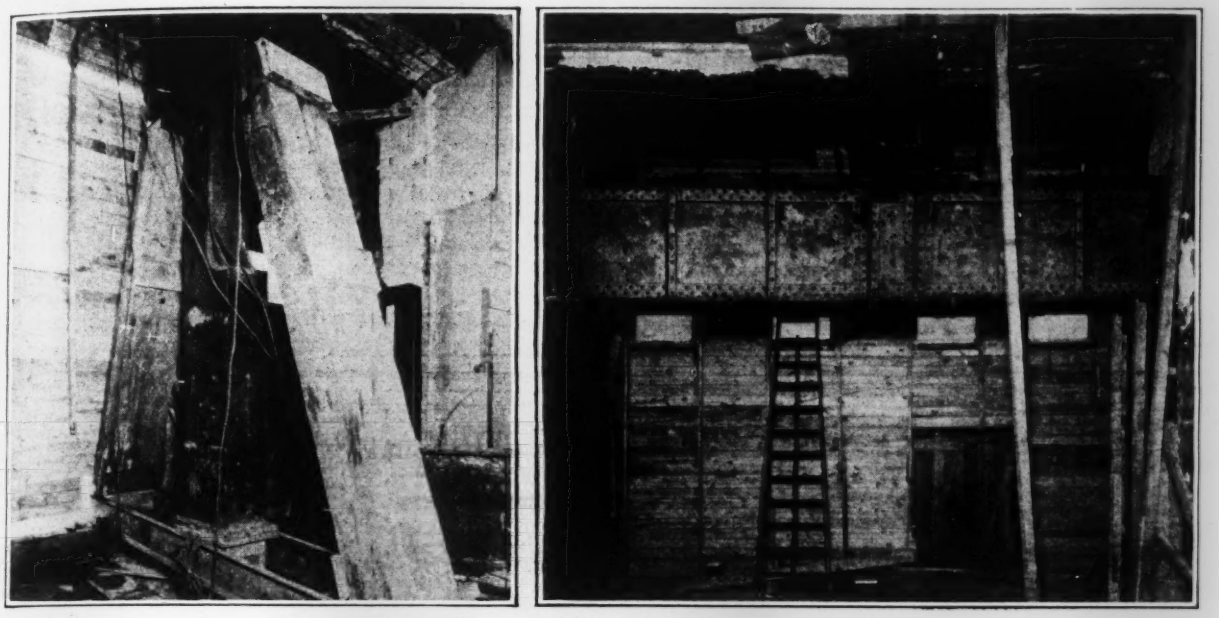
REMOVAL of the lower portion of a cast-iron column in an old ten-story building was recently carried out in Philadelphia by simple methods in an interesting way. The building, 1013 Chestnut St., has cast-iron columns supported on grillage beams in concrete foundations below basement level. To construct a new store front in the first story it became necessary to remove one of the columns. The work was accomplished by the use of a system of steel diaphragms and timber shores for the temporary support of the column at second-floor level while the lower portion of the column was removed and new steel girders and columns were installed to span the store-front opening. The work was so planned and executed that the steelwork of the second floor was not disturbed.

Two short 36-in. built girders or diaphragms were attached to the sides of the column at the bottom of the second-floor beams by 55 1-in. tap bolts in each side. These diaphragms projected forward and back of the column, and served as brackets against which the upper ends of inclined shores could be butted. The shores were 12 x 12-in. timbers tied together with two 12-in. channels. The inclined brace on the street side rested upon the foundation wall of the building, while the other one was framed to 12 x 12-in. timber posts resting upon timber sills on the ground. By wedging the channel tie the shores were lifted sufficiently to take the load of the column. After the shoring was in place, half of the cast-iron column was burned off and the inner one of two transverse girders under the diaphragms was erected, together with two columns supporting it upon a reinforced-concrete girder built on the old footing pier. The old column was then burned through and removed and the outside girder with its supporting columns was erected, completing the new steelwork. This steel frame was jacked up by jacking at the base of the columns, to take the load of the column resting on the girders and relieve the timber supports. The 2½-in. slabs under the new columns were grouted with alumina cement, and the jacks were held until the cement had set. Finally the ends of the diaphragms projecting on the street face of the building were burned off and the first-story section of the old column was completely removed.

The new girders are 17 ft. long, with webs 42 x ⅜ in. and flange angles 6 x 4 x ⅝ in. and two cover plates. They are supported at each end upon new 8-in. H-columns resting upon a new reinforced-concrete foundation girder, as shown by the drawing.



HOW AN UNDERPINNING PROBLEM WAS SOLVED IN PHILADELPHIA

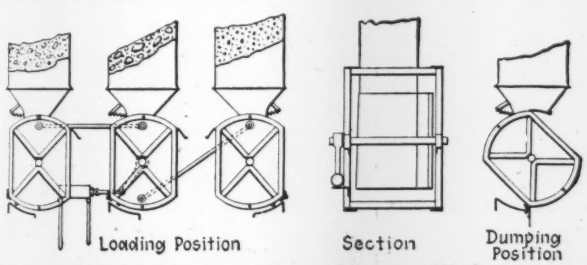


CAST-IRON COLUMN SHORED, AND ITS NEW STEEL SUPPORT

The building is owned by Mayer Lichtenstein and Morris Haber. J. E. Feelstein was architect on the work, Fred W. Abbott was engineer and S. Yellin & Son, Philadelphia, were contractors.

Device for Measuring Aggregates at the Concrete Mixer

A DEVICE for measuring three sizes of aggregate by volume simultaneously at the concrete mixer has been developed and used successfully for some time in connection with the lining of tunnels on the reconstruction of the Yosemite Valley R.R. in the Merced River Canyon, Calif., by A. J. Novelli, engineer for the contractor on this work.



ARRANGEMENT OF AGGREGATE MEASURING DEVICE

This device consists of a series of boxes, one for each size of aggregate, placed under the hoppers, these boxes being adjustable for any volume required. The boxes are connected to the piston of a compressed air cylinder and are operated by a lever on a valve, controlled by the mixer-man. They have openings in the top and bottom, the former being open and the latter closed while filling, and vice versa when dumping.

After being filled the boxes are dumped simultaneously directly into the mixer by turning, at the mixer-man's station, a lever which operates the air cylinder. The boxes are returned to the filling position by reversing the lever, the time required for the entire operation being about 6 seconds. The aggregate in the hoppers is regulated by a spring attachment which prevents clogging and enables the boxes to move freely.

The cost of the device is somewhat more than for other types of volume aggremeters which is, however, believed to be more than made up by the saving in labor cost and the securing of accurate measurement.

For the foregoing data *Engineering News-Record* is indebted to Jerome Newman, consulting engineer on the work.

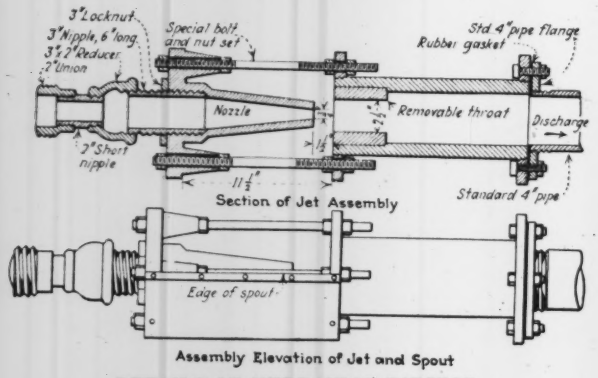
Reduction of Mud Balls in Rapid Sand Filters

By August V. Graf
Chief Chemical Engineer, St. Louis Water-Works

AT THE Chain of Rocks filter plant of the St. Louis water-works, the mud balls forming in the sand bed are disintegrated by jetting the sand from one end of the filter to the opposite end while wash-water is applied to the filter. This is accomplished by means of a hydraulic ejector. The pressure or nozzle end of the ejector is connected to a water plug with a 2½-in. water hose provided with standard pipe fittings. The discharge end of the ejector is fitted with standard pipe and fittings as required. The discharge pipe should be so assembled that it will act as a hanger for the ejector, thus enabling the latter to be held in the floating sand at any desired depth. At this plant the discharge pipe is carried horizontally from the ejector for a few feet, then with a 4-in. elbow and length of pipe the line is carried vertically, terminating in another 4-in. elbow and a long length of horizontal pipe extending toward the opposite end of the filter and resting on the concrete cross-beams. The vertical distance from the lower edge of the last length of the horizontal pipe to the edge of the spout on the ejector should be made such that, when the apparatus is hung on the cross-beams, the edge of the spout will be about 3 or 4 in. below the surface of the stationary sand. At the extreme end of the last length of horizontal pipe, the line is continued vertically downward for a short distance and there the discharge is reduced to 2½ in. with a 4x2½-in. reducer and a short 2½-in. nipple.

Under the discharge is placed a wooden box about 4 ft. high and 15 in. square, open at both ends and provided with three sloping screens, each 15x12 in. in plan. The screens are so arranged that one discharges onto another, while fastened to the top screen there is a small steel plate against which the discharge from the ejector impinges. This steel plate tends to further disintegrate the mud balls.

Underneath this box there should be suspended a ½-in. mesh wire basket 2½ ft. square by 6 in. deep, the bottom of which should be a few inches above the overflow edge of the wash-water troughs. This will retain



DETAILS OF HYDRAULIC EJECTOR

any small gravel that may come through the ejector. As fine gravel accumulates on this screen, it should be removed and scattered uniformly over the area of the filter while the wash-water is being applied. Without this screen fine gravel would tend to pile up underneath the box and cause an unevenness in the surface of the gravel bed.

When ready for jetting, the filter is first given a normal wash and then while the wash-water is still being applied, the apparatus is lowered into place. The rate of wash is then cut to about 5 gal. per sq.ft. per minute, which is continued for 15 min. after which the rate of wash is momentarily raised to 10 gal. in order to level the sand bed. At the Chain of Rocks plant this increase and decrease of wash-water is continued every 15 min. for 5 hr., after which the apparatus is moved to the next filter. The amount of wash-water used during the 5-hr. period amounts to about 1,430 gal. per sq.ft. of filter area. The ejector may be moved about by four men.

By thus jetting the sand in the filters once every six months, the mud balls are very considerably reduced and part of the coating of the sand grains due to softening of the water is removed.

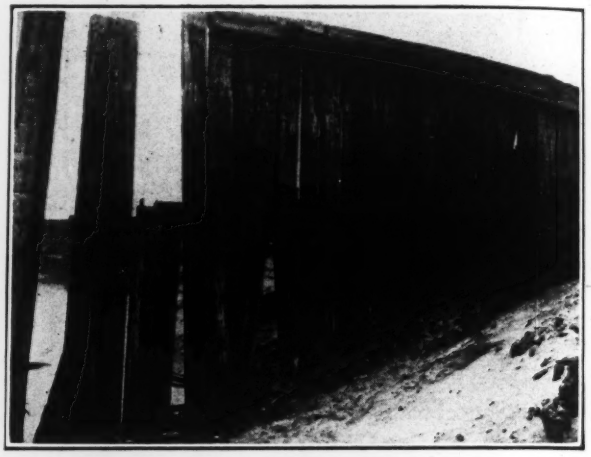
How Cutoff Piles Looked Uncovered

IN addition to puddle core-walls, earth dams of moderate height are frequently supplied with sheetpiles to intercept any water that may course through a pervious stratum below the foundation layers. What one section of Wakefield sheetpiling cutoffs looked like was disclosed recently in the Southwest when the embankment was overtopped and the material washed away from 230 ft. of the sheeting, some of it showing 20 ft. of the piles. The piles were made up of 3x12-in. planks and were spliced to make up a 50-ft. length. They were driven through sand to shale, probably with a steam

From Job and Office

Hints that Cut Cost and Time

hammer without jets. That the work was absolutely a waste of time and money so far as preventing the passage of water needs no words to explain the accompanying illustration. "Overdriven, buckled, telescoped, broken, broomed, out of line the cutoff piles would hardly stop a dog, let alone water," said the engineer who handed the *Engineering News-Record* correspondent the picture with the injunction to preserve his incognito. In consequence it will be unavailing to write to the editor for "more details" but the designer



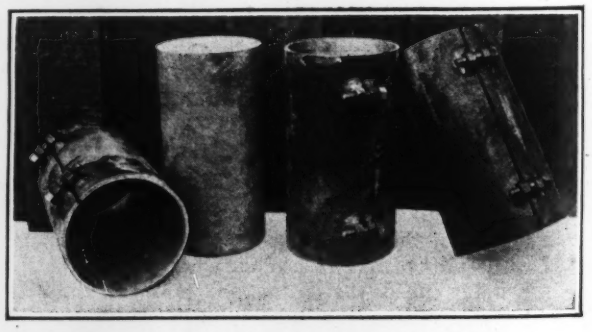
WAKEFIELD SHEETPILES UNCOVERED BY OVERTOPPED RESERVOIR

Splicing was one point of weakness but piles did not follow, were over-driven, broken, broomed and split. Concrete header on top broken up by the weaving of piles.

should think twice and learn local conditions before building up a false sense of security with sheetpiling of this length which may be driven under the same conditions as those in the illustration.

Cylinders for Concrete Samples Made Up on the Job

IN equipping the field laboratory for testing cement on the Balch project now being constructed by the San Joaquin Light & Power Corporation in California, a supply of cylindrical forms was required, in which to



FORMS FOR CONCRETE COMPRESSION SAMPLE

prepare 6 x 12-in. concrete cylinders as samples for compression tests. It was decided to make these cylinders in the machine shop on the job, and this was

From Job and Office

For Contractor and Engineer

done at a cost of $4 per cylinder as compared to a price of about $20 per cylinder that would have been paid for factory-made laboratory equipment.

Standard 6-in. pipe cut to lengths of exactly 12 in. was used for these cylinders. The first operation was to machine a smooth interior finish, after which a ¼-in. slot was cut along one side. Two pairs of lugs were then welded close to this slot and drilled for the ½-in. bolts used to draw the edges of the slot together. Each cylinder was calipered to give the exact cross-sectional area with the slot closed. The spring in the steel pipe, as it automatically opens the slot when the bolts are loosened, nicely separates the form from the concrete sample when the cylinder is removed.

Weighted Canvas Controls Quicksand While Concrete Is Poured

By R. J. Reigeluth

C. W. Blakeslee & Sons, New Haven, Conn.

BUILDING a tunnel on quicksand within 10 ft. of a power house wall may involve unique construction methods, for instance, keeping the trench filled with water while excavating and covering the quicksand with canvas, to form a base for the concrete mat.

In order to double the capacity of the Steel Point Power Plant of the United Illuminating Co., Bridgeport, Conn., a new intake tunnel was required. Property limitations along the harbor made it necessary to run this tunnel just outside of the power house within which large generators and turbines operate in exact alignment. During excavation quicksand was encountered at 18 ft. below high water level. Samples, on test, indicated a state of suspension which is very difficult to control. Working in this material required caution not to undermine the power house foundations.

The tunnel, 339 ft. long, was constructed in three parts. A cofferdam 15 ft. wide was built of 40-ft. steel sheeting driven 15 ft. below grade. The excavation inside the dam was carried down to elevation +5 by means of a clamshell bucket. At that point the bottom began to "boil." The excavated area was immediately flooded by reversing the pumps and a full head of water maintained at all tides to keep the material in equilibrium. Excavation was then continued to —5 by operating the clamshell under water.

When the excavation had attained sufficient depth, a diver leveled the bottom with a water jet. He then placed a 25-oz. duck covering over the entire bottom of one section and put 500-lb. precast concrete blocks on the canvas at regular intervals to hold it in place. A concrete mat 5 ft. thick was then deposited. After a period of twenty-one days the water was pumped out and the bottom was found to hold perfectly.

The canvas insured a full depth of concrete throughout the entire slab. Ordinarily depositing the concrete would have pushed a wave of sand ahead of it and made thin spots in the slab. It also prevented the wet concrete from mixing with the sand when it was deposited which would have decreased the strength. In addition, it provided an almost impervious membrane between the quicksand bottom and the concrete. This protected from blow-outs due to unbalanced pressure.

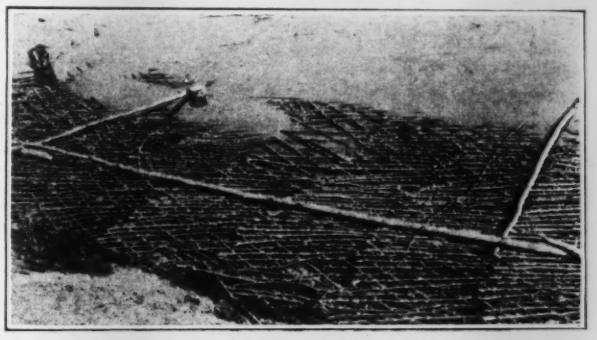
The contractors were C. W. Blakeslee & Sons of New Haven, Conn., the superintendent in charge being William Powell. Westcott & Mapes, Inc., of New Haven were the designing engineers, while E. J. Beugler of Cheshire, Conn., was consulting engineer.

Advantages Shown for Wire-Willow Mattress Over Basket-Weave Type

By F. Y. Parker

Assistant Engineer, War Department, Engineer Office, Kansas City, Mo.

THE increasing scarcity of weaving brush on the Missouri River between Kansas City and St. Louis has caused several types of experimental mattress to be tested. The type here described was more rapidly constructed and required not only less ballast but approximately one-third less willows than the standard basket weave type. Moreover bar-growth willows one season old were effectively used for weaving. Finally, the cost was about $2 less per 100 sq.ft. than that for the standard mattress.



MATTRESS OF WILLOWS WOVEN ON A NO. 9 WIRE MESH

The foundation or web of this mattress is No. 9 galvanized wire mesh 6 in. square and 54 in. wide. Through alternate top and bottom meshes brush was thrust on the forward weave and duplicated on the reverse weave through the open meshes; stiffening poles and cables were placed as usual. In weaving, the brush tops were downstream and each section of wire mesh was laid over the previous sections until the brush tops and wire sections were clipped together at the edges.

Two recent uses of this type mattress follow. In one instance an ordinary basket weave mattress had been constructed on a sand bar as a foot mattress to a private revetment. Subsequent high water deposited about a foot of silt over the top but a later shift of the channel eroded the bar, undermining the outer third of the mattress causing it to drop, and threatened rapid destruction of the revetment. The method of repair was carefully to wash the top silt from the mattress for 20 to 30 ft. shoreward, to cover the break with wire-willow mattress and then to reballast.

The other case was a foundation mattress for a 1,200-ft. dike. The mattress was constructed across a dry sand bar, the driving of the piling on the dike alignment being accomplished during the succeeding high water. The middle fifth of the 75-ft. mattress on the dike alignment was constructed wholly of brush, on each side of which was a strip of wire-willow mattress 30 ft. wide. The use of wire-willow mattress saved $1,200.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Early Days of Separate Sludge Digestion

Sir—I was interested in the editorial in your issue of May 20, p. 797, entitled "Reversion to Type," and its discussion of the Cameron septic tank and the two-story tanks of the Lawrence Experiment Station, of Travis and of Imhoff. To recall what is now more or less ancient history but perhaps interesting to the present generation because of its age, allow me to present some of the old data.

In an article read before the American Public Health Association at Minneapolis, Oct. 31, 1899, I stated: "I believe a modification of the septic tank could be constructed intended to treat only the matters in suspension in the sewage and settled out daily while passing through ordinary settling tanks, flushing this accumulated sludge when necessary into a septic tank." And in the report of the Lawrence Experiment Station for 1899, I said: "The observation that the stronger the sewage entering a septic tank the greater the percentage of organic matter suggests the idea that where exceedingly large volumes of sewage are to be purified . . . the sewage could be passed through ordinary settling tanks so constructed that the sludge settling to the bottom of these tanks could be flushed into a septic tank and this sludge then be treated by septic tank action instead of attempting to treat the whole volume of sewage."

Such a tank was put in operation Nov. 15, 1899, and it was of the true two-story type. The Travis and Imhoff tanks were both based upon the operation and results of this tank, and this fact has been acknowledged by both of them: By Travis in a pamphlet published many years ago, and by Imhoff in a letter to the writer dated Sept. 9, 1912, and in a paper read by him before the International Congress of Demography and Hygiene held at Washington that year. The pertinent portion of Dr. Imhoff's letter is:

"I have to read a paper in Washington the 25th about sludge disposal. There is one very important thing I wish to ask you. My opinion about separate sludge digestion is (so far as I could ascertain from printed publications) that such sludge treatment first was tried by you, as published in your report of 1899 and 1900. Is your opinion still the same or do you know any other publication by engineers or chemists who tried it [separate sludge digestion] before you? Have you any other publications written by yourself in which is said anything about that question before 1903 when Travis wrote [on the same subject]?"

About 1912 some controversy arose between Imhoff and Travis in regard to their respective tanks and patents and the case was heard before the Imperial Patent Court of Germany. (See Report, Lawrence Experiment Station, 1913, pp. 272 and 273.) Portions of Claims 1 and 2 of the Travis patent follow:

"Claim 1—Process for the biological treatment of sewage by means of separate treatment of the solid and liquid constituents characterized by the following: The sewage passing through **one** or more closed or open settling spaces at such a speed as to permit the lighter particles to come to the surface and the heavier to sink to the bottom and to pass through openings in it with a portion of the liquid into a liquefying space situated below the settling spaces, in which they are partly decomposed and liquefied through biological action, whence the liquid passes out of the liquefying space over weirs to one or more filters through which it passes upward in known manner, etc.

"Claim 2—Apparatus for carrying out Claim 1 characterized as follows: Combining the settling chamber (a) and the liquefying chamber (b) in a closed tank in such a manner that the settling space arranged above the liquefying space, etc."

The judgment rendered, in 1912, is in part: "It need not be settled here whether these differences are material or not, as it is clear that compared with the purification plant described in the report of the experimental station at Lawrence of the State Board of Health of Massachusetts, Boston, 1899 (31st annual report, p. 422), the protected process contains nothing new, which is contended by the claimant. The purification process there employed according to this report is exactly the same as that of the patent attacked. The sewage was passed through ordinary settling tanks and the sludge collected at its bottom was at the same time flushed into a septic tank, where alone it was subject to septicization. The defendants contend, however, from the fact that only ordinary settling spaces are mentioned in the Boston report, and that nothing is said about the continuous removal of the sludge out of the settling spaces, that it must be concluded that the process described in the report was only worked intermittently and that a continuous flow through the plant as in the case of the patent attacked, had not taken place. These contentions are, however, not justified, etc."

Certain claims of the Emscher Drainage Board acting for Imhoff were disallowed and the court stated in its final conclusion that "the division of the official costs is justified by the consideration that each party has partly lost its case."

In this German case, testimony was given by the writer and a drawing of the Lawrence tank of 1899 also presented.

It was of course true as Travis claimed that sewage was not passing continuously through the upper section of the Lawrence tank, that is, was not flowing twenty-four hours.

As I stated in the beginning of this letter, this is at the present time more or less ancient history but it is perhaps well once in a while to make clear how much the various modern processes of sewage purification owe to the Lawrence Experiment Station which for 38 years has been giving to the world information concerning this and other sanitary subjects.

H. W. CLARK,
Chief Chemist, Massachusetts Department of Public Health and Director of the Lawrence Experiment Station.

Boston, Mass.,
June 8, 1926.

Do Standard Specifications for Quality Improve Practice?

Sir—I was very much interested in your editorial comment (*Engineering News-Record* of June 3, p. 885) on Dr. Mathews' criticism of standardization of specifications. I have for a number of years been associated with committees engaged in the preparation or revision of standard specifications. I have served as a member of one sectional committee of the American Engineering Standards Committee that has just completed its work after about 4½ years' discussion, most of which has been by correspondence, and am still actively serving on another similar A.E.S.C. committee that has been functioning since 1923, most of whose work has been accomplished by round-table discussion, but whose task is still uncompleted. The general question that you have raised in your editorial, namely, "Are standard quality specifications worth while when measured in terms of the ultimate result?" is one to which I have given considerable thought during the course of my activities along the above lines, and there is much that can be said pro and con on the subject.

There is, however, one general thought that has always recurred to me in my own analysis of the matter, which is that structures must be designed according to some specification and it is essential that the materials of which they are to be constructed meet the requirements of such specification. If there are a number of manufacturers whose products meet these requirements, all of which are being manufactured under different specifications, it is logical to conclude that there must be one best specification for the purpose, or one which will permit manufacturing methods involving the greatest economies and which consequently, barring the question of possible price control, should result in the lowest possible selling price. The A.E.S.C., in the consideration it is now giving the matter of "Guaranteed Quality under Specifications" has expressed the thought in these words: "Putting manufacture more on the basis of generally known characteristics interpreted in the terms of specifications and grades might, on account of the extension of mass production, permit the manufacture of a large quantity of staple goods that could be sold on a wide market because of their known quality and presumably high value in relation to price. Moreover, it would seem that the manufacturer would be placed in a better position with respect to his purchases of the raw materials and constituent parts entering into his products."

The question, therefore, resolves itself into one of economics. If the preceding analysis is sound then the logical conclusion would seem to be that standard quality specifications, acceptable to the majority interests, are justified and desirable. This would enable a manufacturer to produce in advance of actual requirements, during otherwise slack periods, many materials for which he was reasonably assured of a future demand, and thus operate his plant in the most efficient and economical manner; the economies could then be reflected in lower prices to the consumer, at the same time assuring him better deliveries, and would assure the designer of structures a reasonable uniformity of material regardless of the source of supply.

I believe that the question of standardization must be looked at from the broader point of view before judgment is passed. To me, it has always seemed to be a matter of trying to secure the maximum benefit to the greatest number of interests concerned. It has never been my understanding that it was ever the thought of those advocating standardization of specifications that, once a certain specification had been standardized, such for example as has been done in the case of portland cement, all further attempt to improve the physical or other characteristics of that product should cease. The compilation and general acceptance of such a specification merely mean that a measuring stick has been set up by which that particular material is to be gaged and tested. Such a specification is not necessarily permanent in character, but simply constitutes a goal which all manufacturers of that product must reach if they would remain in business and beyond which all should strive to pass as far as they can. Standards are always subject to revision as expediency requires, but this is no reason why the industry should not have the advantages of them in the meantime. Modern business is founded upon the principle of "the survival of the fittest" and the manufacturer or business man who is content to sit quietly back and be satisfied with past performances is soon scheduled to pass out of the picture in these days of keen business competition, or be absorbed by his more progressive competitors.

Quality specifications, if their purpose is not properly understood and they are not used accordingly, would certainly tend, as you stated, to straitjacket progress. On the other hand, quality specifications, especially when prepared under the supervision and most careful scrutiny of such agencies as the A.E.S.C. sectional committees, certainly meet the immediate requirements of the maximum number concerned and are acceptable to the remainder. When the necessity arises, there is a procedure available for their revision but they are protected against frequent changes merely to suit the ideas of a few individuals, and it is in this way that manufacturing is stabilized to the fullest extent.

The advantage of nationally recognized standards in connection with the marketing of goods for foreign trade is of considerable importance, and would undoubtedly tend to reduce trade disputes and litigation arising from misunderstandings which are due largely to the differences in trade practices and industrial conditions in the two countries involved.

Rather than "exalting and hall-marking" the mediocre, quality specifications will generally be found to have the effect of barring from the market goods below a certain minimum standard, unless such goods are sold at prices duly reflecting their want of the standard quality.

Newark, N. J. HOWARD H. GEORGE,
June 10. Assistant to Chief Engineer, Public Service Production Co.

[If in this last paragraph, our correspondent means to say that standard specifications tend to eliminate goods *above as well as below* the set standard, then we are not far from being in hearty agreement with him. But perhaps this very point is at issue; if so, we must leave its discussion to a later occasion.—EDITOR.]

Trusses in Commodore Perry Hotel

Sir—In your June 10 issue, p. 956, there appears a letter criticising the use of steel trusses in hotel design to carry upper stories above large public rooms, and referring especially to the Commodore Perry Hotel, being erected in this city. As I am responsible for the structural design of the Commodore Perry, I am writing to give your correspondent and readers such data as are necessary to consider in forming an opinion regarding the propriety of the design.

Trusses are used, as stated by your correspondent, to carry the upper stories over public rooms. These trusses will have all members and connections solidly enclosed in concrete. The trusses are not walled in, as your correspondent assumes, but are accessible from a low story serving as a pipe gallery.

The use of heavy girders and trusses to transfer the loads from upper-story columns beyond the limits of large rooms in the lower stories is frequently required in modern architectural practice. When such construction is resorted to the most careful attention should be given to fireproofing methods.

GEORGE V. RHINES,
Toledo, Ohio, Mills, Rhines, Bellman & Nordhoff,
June 16, 1926. Architects.

Schenectady Sewage Chlorination Studies

Sir — Mr. Cohn's Schenectady experiments on sewage chlorination, reported in your issue of June 10, p. 943, indicate that the influent to trickling filters can be relatively heavily chlorinated without materially impairing the efficiency of the filters. Experience elsewhere has resulted in impaired filter efficiency. It is probab'e that immature or overloaded filters would have their efficiency diminished. It is also improbable that the filters at Schenectady would have continued to function efficiently had the heavy chlorination been maintained. The results do indicate that by intermittent heavy doses of chlorine or hypochlorite the moth flies may be kept from becoming too prevalent and that continuous application of small quantities of chlorine will minimize odors.

The cost of the chlorination treatment has not been referred to by Mr. Cohn. If the minimum quantity used in the experiments, 4 p.p.m., were to be applied continuously, the additional cost of treatment would be about $2.50 per m.g., assuming chlorine at 10c. per lb. If chlorination permits higher rates of treatment this increased cost would be offset to the extent that capital charges were reduced. As regards intermittent application of hypochlorite in single large doses during the fly season, the purchase of the chemical would not materially increase the cost of treatment.

On the whole the experiments have been distinctly encouraging and it is to be hoped that research will be continued, not only at Schenectady but elsewhere, along the lines begun by Mr. Cohn.

H. P. EDDY,
Boston, Mass., Consulting Engineer.
June 12, 1926.

Sir—Mr. Cohn's tests emphasize one important property of the trickling filter, namely its ruggedness and ability to withstand inhibitory influences and temporary overloads. In our studies on the treatment of industrial wastes at Chicago we have found the trickling filter more adaptable to variations in strength and composition of such wastes than the activated-sludge process.

The continuous use of liquid chlorine at the rates found necessary at Schenectady would be quite extensive, costing probably from $3 to $4 per m.g. The Schenectady sewage is comparatively weak, and the tank effluent used in these tests was quite dilute, with an oxygen demand of only 64 p.p.m. and 40 p.p.m. suspended solids. With even a moderately strong, stale sewage the cost of continuous application of chlorine would be prohibitive, unless a very acute emergency might exist with regard to odors and flies. The most practical solution of the fly problem seems to be the application of chlorine as calcium hypochlorite. The cost of this treatment should be far less than the cost of continuous application of liquid chlorine. While hypo would not eliminate odors, it would probably lessen them by reducing the tendency toward pooling and by removing excessive growths of surface films.

As to the effect of nitrification, I do not believe the tests have demonstrated conclusively that the large amounts of chlorine applied toward the end of the tests, in October, would not be harmful to the normal working of the beds. In order to apply more than approximately 10 p.p.m. of chlorine it was necessary to divert a large proportion of the flow from dosing tank *B* to dosing tank *A*. The rate on filter *A* was thus increased to about 5 m.g.d. per acre while the rate on the chlorinated filter *B* was reduced to less than 1 m.g.d. per acre. This light loading helped filter *B* to withstand the excessive amounts of chlorine. Even with the increased loading filter *A* produced more nitrate than filter *B* from Oct. 8 to 16. The results indicate a very

light loading on the Schenectady filters, with nitrification at its maximum at the time of the tests. During August and September the tests demonstrated that the filters could stand up to 10 p.p.m. chlorine with an almost sterile influent. The pronounced unloading of filter *B* may have been without significance during the period of the tests, but it seems likely that nitrification and stabilization could not be continued long with a sterile influent and a filmless, partially-sterilized filter bed.

The absorption of chlorine was quite variable. With 6 p.p.m. chlorine applied, there was practically none at the filter nozzles; with 10 p.p.m., about 2 p.p.m. at the nozzles and traces in the effluent; with 25 to 30 p.p.m. applied, less than 5 p.p.m. at the nozzles and 0.2 p.p.m. or less in the effluent. It would be interesting to know whether the analyses indicate an appreciable oxidation of the nitrogen or carbonaceous compounds in the Imhoff effluent by these large amounts of chlorine. The absorption of 20 to 25 p.p.m. ought to show a considerable oxidation.

F. W. MOHLMAN,
Chief Chemist, Sanitary District of Chicago.

Chicago, Ill.,
June 14, 1926.

Sir—The fact that Mr. Cohn finds but a slight decrease in efficiency with applications of chlorine is encouraging but constitutes only a step in the direction of increasing efficiency and consequent elimination of nuisances. Psychoda fly control was the initial object of the study, and was apparently attained, although "visual observation" is often a poor, unconvincing measuring stick.

The statement is made that the nitrifying bacteria in the beds were affected by the increase in chlorine strength and it is assumed that they soon became accustomed to the new conditions. This would mean that these organisms were readily able to adjust their physiological activities to poisons. It is well known that poisons, in suitable concentrations, may be stimulating as well as toxic to bacteria, but this does not mean that the bacteria are accustomed to the poisons. The general theory is that disinfection is chemical in nature, gradual and not an instantaneous process, probably highly complex in regard to reaction between cell and disinfectant. It was pointed out by Ricket in 1892 that poisonous salts, added to bacterial suspensions, were at different concentrations (a) indifferent, (b) stimulating, (c) inhibitive, (d) toxic (Comt. Rend., vol. 114, p. 1492; also see Falk & Winslow, Jour. Bact., Jan., 1926.). It may be, therefore, that the bacteria did not become accustomed but were reacting towards the chlorine in one or more of the four ways indicated. Evidence for this reasoning may be found in the nitrates curves, which show reasonable similarity but fairly persistent lower values for the chlorinated effluent, except, perhaps, with the higher applications. It is possible that the chlorine was active in the following ways: indifferent, stimulating, somewhat inhibitive, but practically never toxic to the organisms if they were affected at all. More likely, with lower chlorine application the chlorine was absorbed before it reached the nitrifying organisms, because we have shown that nitrification takes place mostly in the bottom of the beds (N. J. Ag. Exp. Sta. Bull. 390). The curve for residual chlorine in Mr. Cohn's paper indicates that no residual chlorine was present until rather high quantities were added. It seems therefore than the chlorine was absorbed by the colloidal material present in the influent and by the organic material present in the top layers of the beds. Since the flies breed only in the few top inches of the bed, the film nearest the top, being most affected, is removed and the larvae washed out.

Another question is whether other than nitrifying bacteria were not affected. In this respect it is extremely interesting to note that the amount of colloidal material increased and stability decreased with the increase in chlorine. If, in addition, the absence of odor is kept in mind it seems clear that chlorination inhibited the activities of or was actively toxic to the putrifying organism carried on the beds with the sewage and those present in the top layers. Our laboratory studies show that colloidal material is continuously produced and further broken down by bacterial action. But different organisms under different conditions will accomplish the work. If putrefactive organisms perform the initial work and they are inhibited or killed off, the colloidal material, which adsorbs or absorbs the chlorine, remains unattacked and passes out. At the same time the biochemical oxygen demand should be higher in the treated material and no direct relation should exist between stability and B.O.D., for portions of the colloidal material are coming through in different stages of decomposition. Stability as such, however, should be lower in treated samples. At the same time, when the partly attacked material is completely checked in its decomposition by the chlorine, B.O.D. values should be higher. This was actually the case near the end of the experiment.

Mr. Cohn's large-scale experiments are a step in the right direction to increase the efficiency of the beds. The aim is to decrease protozoa and fungi to an efficient minimum and increase the bacterial population to an efficient maximum. This apparently can be done. Numerous laboratory experiments show that protozoa and fungi can be decreased, at the same time increasing or decreasing the numbers of bacteria at will, with different concentrations of poisonous substances. The following is cited from a series of experiments on selective killing in tank liquid:

Material	P.P.M.	Bacteria Million per C.C.	Protozoa per C.C.
$CuSO_4$	0	34	11,300
$CuSO_4$	1	67	7,800
$CuSO_4$	2	68	5,000
$CuSO_4$	10	140	5,000
$HgCl_2$	0	32	11,200
$HgCl_2$	1	97	3,800
$HgCl_2$	2	78	5,500
$HgCl_2$	10	55	2,200

The author has not considered the effect of temperature on the rapidity of the action of chlorine. It is possible that more chlorine should be added in the early and late parts of the season to obtain results than during midsummer; also the results obtained during the beginning of September might not be comparable with the results from middle October.

WILLIAM RUDOLFS,
Chief, Sewage Investigations Laboratory.

New Brunswick, N. J.,
June 12, 1926.

Sir—The paramount objection raised to chlorination of tank effluent prior to filtration, as practised at Schenectady, seems to be the great cost of the treatment. It should be borne in mind that the study at excessive chlorination rates was made solely to ascertain the quantity of gas required to destroy the nitrification efficiency of the units. It is evident to the writer that change of rate of filtration, as carried out during the latter portion of the study, has a distinct effect on nitrification, but the fact still remains that the treated beds withstood the short test with remarkable fortitude.

Having determined last year that ordinary rates of chlorination had no apparent deleterious effect on the filters, plans are now being made to chlorinate this summer at a rate of about 4 p.p.m. in order to ascertain the benefit of such treatment on psychoda, odors and bed surface and nozzle conditions. Such a treatment would cost about $2.25 p.m.g. of sewage and would not impose an excessive burden upon a plant that was in need of such control work.

A one-month run just completed indicates rather definitely that chlorination of raw sewage can be carried out more economically than chlorination of the effluent from the Schenectady tanks. Application of liquid chlorine in dosages of roughly 5 p.p.m. gives promise of producing a definite chlorine residual at the effluent of the tanks; that is in excess of the residual chlorine obtained in the tank effluent after direct chlorination in the dosing tank, at similar rates of application. If this holds true, the chlorination of raw sewage can be carried out cheaper and will have the advantage of reducing septic tendencies in the Imhoff tanks themselves and will overcome the production of odors at the dosing tanks that results from the agitation of the liquid on going over the weirs and steps of the chamber. It is tentatively planned to chlorinate all of the raw sewage entering the Schenectady tanks at a rate that will give a residual chlorine at the effluent weirs and to ascertain the effect on both the tanks and the filters. It may be found that such work can be carried out much cheaper than last year's study would indicate, and may thus overcome the objections of lack of economy that are raised.

MORRIS M. COHN.

Schenectady, N. Y.,
June 19, 1926.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Engineering Educators Meet at Iowa University

Educational Research Results—Board of Investigation and Co-ordination Presents Valuable Report

Convention Report by Donald D. Curtis, Department of Mechanics and Hydraulics, State University of Iowa

The Society for the Promotion of Engineering Education held its thirty-fourth annual convention meeting at the State University of Iowa, Iowa City, June 16 to 18. The attendance was 312, with more than eighty institutions, thirty-eight states, and Canada and Brazil represented. The sudden and untimely death of Dean Wm. G. Raymond of the State University of Iowa on June 17 cast a heavy cloud over the atmosphere of the gathering; all following social features were abandoned, save some functions for the ladies and the annual banquet.

The meetings were unusually fruitful and stimulating. The character of the papers was such as to lead to spirited and thought-provoking discussion, in most cases limited only by the time available. It was a feature of the early sessions that the president called the papers strictly to the time limit, and stopped discussion immediately on expiration of the scheduled time.

As always, the joint meeting of Deans and Administrative Officers and Teachers of English, although a preliminary meeting, was well attended. The group's discussion was summarized by Professor Nelson as pointing to two objectives, training the engineer to speak and write clearly and forcefully, and fostering regard for literature. For the first of these, the consensus of opinion was that in addition to the formal courses, as ordinarily given, the full co-operation of all departments in demanding correctness in expression, oral and written, was essential to successful mastery of English by the student. For the second, the recommendation was to permit election of literature courses.

Educational Research Results

Almost exclusively the set program was devoted to results and interpretation of the findings of the research started some years ago to co-ordinate engineering colleges. The amount of energy expended and the body of fact and finding, theory and synthesis, presented was tremendous. Dean Marston, reporting as chairman of the A.S.C.E. committee on Engineering Education, gave composite results of questionnaires sent to some 1,500 members of A.S.C.E., A.S.M.E., and A.I.E.E. From these, it was apparent that there was a general appeal for broadening of college courses and a tendency to hold to the engineering course but to have it include some business training. Some less than half the replies indicated a preference for functional division in courses as opposed to technical division, that is, sales, design, and such as opposed to civil, mechanical, and such.

That guidance of high school students in choosing engineering as a career should be furnished by conferences of high school teachers and teachers of engineering, addresses on engineering to high schools, distribution of especially prepared literature to high schools, and dissemination of information by various means, such as radio and extension, was the contention of a portion of a paper on engineering students and graduates. It was pointed out that less than half the students entering upon technical courses had any conception of their chosen field.

The matter of elimination of engineering students has attracted a good deal of attention as evidenced by the repeated queries as to how to remedy the situation in which the eliminations are so numerous as at present, with the too-frequent accompanying personal injury to students. Dean Seashore, State University of Iowa, offered the preliminary placement examinations, which are yearly being improved, as the means by which the student may be warned in advance of entering a course for which he is unfitted. By this method, the matter is handled in a kindly way, the student being shown by

(*Concluded on p.* 1040)

Engineering Fifty Years Ago

From *Engineering News*, June, 1876

Notes

THE Erie road has completed the laying of a third rail between Buffalo and Elmira.

* * *

The Canadian Government is soliciting bids for the construction of sections of the Pacific Railway between Lake Superior and the Pacific Ocean, contractors to receive lands or proceeds of lands at the rate of 20,000 acres, and cash at the rate of $10,000 per mile, together with interest at the rate of 4 per cent per annum for twenty-five years from the completion of the work, or any further sum which may be stipulated in contract.

* * *

The Hudson River Tunnel Company, which has been delayed more than a year by injunctions, has again resumed operations at the shaft in Jersey City.

Much New Construction for Federal Reclamation

$7,431,000 Appropriated Includes Some New Projects in Oregon, Montana and Utah

From the text of the Reclamation Appropriation Bill, just made public, it appears that large appropriations were made for the construction of new projects. The total carried by the bill is $7,431,000 from the reclamation fund, and the sums of $35,000 and $15,000 respectively for contributing to Yuma levee maintenance and for investigations of arid, semi-arid, swamp, and cutover timberland in any of the states with respect to development. Separate bills further make appropriations of $25,000 to continue co-operative study of irrigation along the Columbia River.

New Projects

Appropriations for new projects contained in the main appropriation bill include the Owyhee, Vale, and Baker projects in Oregon, an extension of the Sun River project in Montana, and the Echo reservoir and associated work of the Salt Lake Basin project in Utah. The appropriation for Owyhee is the balance of $315,000 appropriated in 1924 and reappropriated a year later; for Vale, the unexpended balance of $500,000 appropriated a year ago, with authority to purchase an interest in the existing Warm Springs storage reservoir and for the construction of drainage works for the Warm Springs and Vale projects. For Baker, the unexpended balance of the 1925 appropriation is appropriated; for Echo reservoir, the unexpended balance of the 1925 appropriation, and for Spanish Springs division of Newlands project, the unexpended balance of $500,000 appropriated in 1925. A similar appropriation is made for the completion of the works on the Kittitas Division of the Yakima project.

Repayment Provisions

An important proviso made in respect to the new projects is that no money shall be expended until satisfactory contracts have been made with irrigation districts for repayment of the cost of the works; that all landholdings over 160 irrigable acres shall have their sale prices fixed by the Secretary of the Interior and shall not receive water if not sold at such price unless half the construction charges against such land have been paid; that operation and maintenance charges shall be paid in advance each year, but that the first year's operation charges after public notice shall be paid as part of the construction cost; that the state authorities may co-operate with the United States in promoting the settlement of the projects, and in securing and selecting settlers. Generally, the significant change over prior laws is the allowing of repay-

ment of construction cost in 40 years instead of in 20 years as heretofore, this cost to bear no interest.

Of the old projects, partial abandonment of some divisions is provided for: On the Uncompahgre project, Colo., the Secretary is authorized to investigate the feasibility of discontinuing operation of any parts of the project and removing the water users thereon to other lands. A similar provision is made for the Frannie division of the Shoshone project, Wyo., with the further provision that after Dec. 31, 1926, no government money shall be expended for operation or maintenance of this division. No money is appropriated for the King Hill project, but operation or construction is authorized at the expense of the district, for sums to be contributed in advance.

Passenger Trains in Rear End Collision Near Pittsburgh

Shortly after midnight on the morning of June 17 the Cincinnati Limited of the Pennsylvania Railroad bound for New York, ran into the rear end of the Pittsburgh - Washington express near Gray station on the Pennsylvania Railroad 3 miles east of Blairsville, Pa. The Pittsburgh-Washington train had stopped to repair an air hose and was just about to proceed when the accident happened. The three rear sleepers were telescoped and the end of the club car badly smashed, resulting in the death of sixteen persons.

Very meager reports as to the cause of the accident are available at this time, but from statements of the crew it appears that the Cincinnati Limited ran by the fixed signals set against it and warning signals put out by the flagman of the standing train. As the engineer and fireman of the leading locomotive and the engineer of the second locomotive were killed, it is not known how they came to run by the signals set against them, or failed to observe the flare and torpedoes which the rear trainman of the standing train states that he placed 700 ft. back of his train.

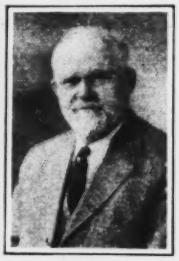
Decision on New Highway Into San Francisco Announced

The California Highway Commission on June 8 authorized advertisement for bids on the proposed $280,000 underpass at South San Francisco that will provide a connection with existing roads for a new highway route down the peninsula. The new highway has been partially completed under the direction of the Highway Commission with funds provided by the City of San Francisco. The underpass was described in *Engineering News-Record*, Nov. 12, 1925, p. 815.

The underpass is designed with side walls that will ultimately support a total of 16 railroad tracks. For the present decks are to be placed for a total of only 7 tracks, the remainder to be added as needed. The cost of the structure is to be apportioned as follows: Southern Pacific R.R., 23.7 per cent; California Highway Commission, 71.2 per cent; and belt Line Ry., 5.1 per cent.

Dean Raymond Dies at Iowa University

William Galt Raymond, dean of the College of Applied Science at the State University of Iowa, Iowa City, died at the University hospital Thursday morning, June 17.



Dean Raymond was born in Princeton, Iowa, in 1859, studied engineering at the University of Kansas and graduated from Washington University with the degree of civil engineer in 1884. Before graduation he worked as an assistant engineer on railway construction and after graduation began teaching at the University of California where he was an instructor in civil engineering from 1884 to 1890. From 1892 until he went to the University of Iowa in 1904 he was Professor of Geodesy, Road Engineering and Topographic Drawing at Rensselaer Polytechnic Institute. Mr. Raymond began his work at Iowa University as Professor of Civil Engineering, becoming Dean of the College of Applied Science when that was organized in 1905.

Dean Raymond's activities were not confined to his college work. He practiced as a consulting engineer and wrote a number of books, some of which, such as his "Plain Surveying," have been standards of engineering instruction for many years. He also took an active part in technical society activities, being a past president of the Society for the Promotion of Engineering Education, which organization was holding its convention at the University at the time of his death; was a past president of the Iowa Engineering Society and a member of the American Society of Civil Engineers and the American Railway Engineering Association. During the war he served on the Iowa State Board of Conciliation for the adjustment of public utility rates.

The degree of Doctor of Laws was awarded to Dean Raymond by Washington University in 1905, and the degree of Doctor of Engineering was awarded to him by Michigan University in 1919.

Allegheny County Opens New 7th St. Bridge

On June 17 the new 7th St. bridge over the Allegheny River, in Pittsburgh, built by the County of Allegheny, was opened to public traffic. This is the first of the three downtown bridges (6th, 7th and 9th Sts.) which are being rebuilt at the order of the War Department to give greater vertical clearance and better arrangement of piers for navigation. The structure is of the self-anchored type. The foundations were built by The Foundation Co. and the superstructure by the American Bridge Co., to designs made by the county Department of Public Works.

Failure of Sunnyside Reservoir Due to Seepage

On the morning of Aprli 28 a break 30 ft. wide occurred in the west wall of the Sunnyside reservoir which is part of the municipal water supply system of Salt Lake City. The reservoir is an artificial basin formed partly by excavation and partly by fill, and is lined with 6 in. of concrete. The dimensions are 140x205 ft. at the bottom, the depth is 30 ft. and the side slopes 1½:1. At the time of failure the water was 23 ft. deep.

Failure is ascribed to leakage which apparently started near the center of the west side and traveled through the embankment diagonally until it encountered the outlet, overflow and washout pipes. From that point it naturally followed these pipes through the fill section. Slight leakage had existed for some time. The first indication of more serious trouble was a small stream of murky water coming through the valve well which was observed by the caretaker. He immediately reported this to the water works department and opened the outlet gate. Forty minutes later the wall was out and the reservoir empty.

The natural ground line intersects the western slope, where the failure occurred, midway between the top and bottom. With the exception of a layer of hardpan 2 ft. thick, about 10 ft. below the ground surface the material is very fine sand.

$12,000,000 Asked for Montreal Harbor Improvements

A government bill to authorize a loan, not to exceed $12,000,000, to the Montreal Harbor Commission, in connection with a big development program, has been introduced in the Canadian House of Commons. The minister of marine and fisheries stated that the current program of the harbor board included $5,400,000 for wharves, piers and basins, $3,155,000 for a grain elevator, $1,342,000 for railways and electrification, $800,000 for dredging, $322,000 for shops and buildings $300,000 for permanent sheds, $155,000 for plant and the remainder for miscellaneous purposes.

Resolutions Against Oil Pollution Adopted by Conference

Delegates of a dozen nations to the International Conference on Oil Pollution of Navigable Waters held at Washington, D. C., beginning June 8, adopted a proposed convention, effective when 5 of the 12 participating nations have signed the agreement. The convention provides for the establishing of areas not less than 50 nor more than 150 miles from shore into which oil or oily substances shall not be discharged from any craft other than war vessels that carry oil or use it as fuel. The limitation as to the amount oil that may be discharged is fixed at "0.05 per cent of crude, fuel or Diesel oil" or enough "to form a film visible to the naked eye."

WASHINGTON NOTES

PRESIDENT COOLIDGE, on June 22, signed the bill appropriating $165,000,000 for highway construction over a period of two years.

THE House has passed the bill authorizing payment of the expenses of three delegates representing the United States at the International Sanitary Conference meeting in Paris, to revise the International Sanitary Convention of 1912.

A SUPPLEMENTAL appropriation of $50,000 for the establishment of a master scale for checking the large scales in use by the railroads and some industrial plants has been asked by the Bureau of Standards. It is contended that there now is no adequate check on the scales used in weighing the $4,500,000,000 worth of freight which the railroads handle each year.

THE House Committee on Irrigation and Reclamation has approved a bill authorizing the Secretary of the Interior to pay assessments against government property on reclamation projects for municipal improvements. The Comptroller General ruled recently that assessments for paving, sewers or similar improvements may not be paid even if the property is benefited without legislative authority.

THE Portland Electric Power Co. of Portland, Ore., has applied to the Federal Power Commission for an amendment to its license which will allow it to take up the second stage of its development on the main fork of the Clackmas River in Clackamas County, Ore. A tunnel 22,000 ft. long will carry the water into the Oak Grove reservoir. An additional 37,500 kw. is to be installed in the Oak Grove power house.

THE Public Lands Committee of the Senate has approved a bill giving the consent of Congress to the opening of negotiations by Idaho, Washington, Wyoming and Oregon looking to a compact with respect to the division of the waters of the Snake River and its tributaries. Any agreement before becoming binding must be approved by the legislature of each state concerned and by Congress.

The Secretary of the Interior in reporting on the bill declares he is "heartily in accord with the plan of adjusting differences relating to the division of the waters of interstate streams by means of compacts between the states involved."

The Committee also approved a similar agreement between Wyoming and South Dakota for the division of the waters of the Belle Fourche and Cheyenne Rivers.

IN CO-OPERATION with the Secretary of War and the Secretary of the Navy the House Military Affairs Committee and the Naval Affairs Committee have prepared a bill intended to encourage the development of aviation. The committees regard the bill as a promising step in the development of aviation for defense and "as a most useful means for fostering the aircraft industry and promoting the art of aviation."

It is planned to throw open the doors of competition to all designers and inventors "even to all those with but limited financial strength." Nation-wide competitions are to be staged and provision made to reward those who bring forward ideas of real merit.

Another objective of the bill is to develop a private air craft industry. A plan is worked out to insure remunerative prices to a large number of producers. The committee does not want to see two or three large manufacturers get all the contracts. Conspiracy among bidders to prevent competition is heavily penalized.

CONSTRUCTION ROAD IN FISH CREEK CANYON

IN LOCATING a construction road to the site of the Horse Mesa dam in the Salt River Canyon, Arizona, engineers of the Salt River Valley Water Users' Association selected a route via the precipitous Fish Creek canyon which enters the main canyon some four miles below the dam site, traversing a region heretofore practically inaccessible. The road winds in continuous curves around bold pinnacles and cliffs where the remnants of ancient cliff dwellings are found, and for several miles threads a canyon whose scenic features rival the Grand Canyon of the Colorado.

The location was made possible by entering a narrow notch near the head of the canyon and then carefully working out a zigzag descent into the canyon with sharp curves just outside the "switchback" class. Having thus descended abruptly to a level below the sheer cliff faces, it was possible to locate on a bench cut for most of the remaining distance through the canyon. To the truck driver on this job, being on the brink of a precipice is daily routine.

The picture shows one of the zigzags in the road where it enters Fish Creek Canyon.

Engineering Educators Meet at Iowa University

(*Concluded from p. 1037*)

the actual evidence that he is unqualified; his aptitude may lie in some particular direction which will be shown in the examination results.

EXTENSION AND CO-OPERATIVE COURSES

Extension courses have been studied by comparison with work in residence, and the conclusion from this study is that, properly administered, such courses may be made to furnish a ready means of keeping the graduate up to date and growing in his field, as well as offering opportunity to men who cannot for some reason attend college. A surprising bit of evidence in the findings is the fact that a large part of the students who had taken work both in residence and in extension considered the influence and personality of the teacher more intense and helpful in extension courses than in residence courses.

Co-operative courses, half of the time being spent in college and half in industry in short-period alternation, have proved valuable in giving the student a perspective of actual working conditions. In many instances such courses permit, through having only half the students in residence at one time, more efficient use of space and equipment in the college. Often the co-operative plan has permitted the utilization of equipment for research which would have been far beyond the means of the institution, the students being granted the use of the facilities of the industry served.

Two dominant notes were sounded throughout the whole discussion whenever teacher requisites were mentioned; the first and more insistent was "can the teacher teach"; the other was "is the teacher qualified as a leader in research and industry." All seemed to agree that the teacher was the most important factor in the effectiveness of any curriculum. One institution considers four chief points, in the order named, in selecting members to its instructional staff—scholarship, teaching ability, professional standing, and aptitude or training in the humanities. Another paper suggested the advisability for the training of teachers in a summer course of a month's duration, with suitable arrangements made for instruction, expense of the young instructors who would attend, scope of the training, and other details.

CURRICULA

In the presentation of the study relating to curricula, the subject of foreign languages evoked a good deal of spirited discussion. Dean Cooley championed the cause of the study of language for the practical reason of possible invasion of foreign fields, and precipitated a warm debate. The findings of fact show that foreign languages are not so much admission requirements as formerly, nor so much required courses of study in engineering colleges. In the course of the discussion some members held that foreign languages had never been demonstrated to have had enough more value than various other so-called cultural subjects to warrant their inclusion to the exclusion of the other courses.

BOARD OF INVESTIGATION

Probably the most important single feature of the convention was the report of the Board of Co-ordination and Investigation. Associate Director Hammond's summary of the fact-gathering stages set forth such a mass of careful, thorough, all-inclusive evidence as to be almost unique in the history of engineering education. Chairman Scott reported on some of the administrative phases of the work. Noteworthy in his statement were the encouragement and appreciation expressed by the various bodies concerned, and their admonition to proceed to the application of the principles evolved from the study.

Director Wickenden made analysis and recommendation on the basis of the facts found in the investigation. His report, throughout, was constructive rather than destructive. The present order, by it, would not be destroyed, or crippled by serious alteration, but rather would be strengthened and amplified until engineering education was more balanced and stabilized in all institutions. By the report, the four year course, with simplification and unification of subject matter, may be confidently expected to give a good general training upon which to build an intense technical knowledge by graduate study, extension courses, or post-scholastic education. The technical engineer of today is called upon to be thoroughly trained in one field and intelligent in several allied fields. This demands broad general training followed by education along with practice. The report repeatedly stressed the fact that concerted action by the colleges is necessary to insure real progress now. It is evident that the colleges alone cannot solve the problem of engineering education, but that the industries, the engineering societies, and the colleges must work together to meet their mutual obligations and serve their mutual interests. In the early fall, a group of deans and executive officers will meet to formulate a program of action to reach practices making for further co-ordination in engineering education.

Because of the death of Dean Raymond, the convention was hastened to a close a half day sooner than had been scheduled by presenting some of the matters of business on the evening which was to have been devoted to the banquet and by cutting short the final discussion period.

The officers for the coming year are: O. M. Leland, Dean of Engineering, University of Minnesota, president; H. W. Tyler, Massachusetts Institute of Technology and W. S. Rodman, University of Virginia, vice-presidents; F. L. Bishop, Dean of Engineering, University of Pittsburgh, secretary; W. O. Wiley, treasurer; Miss Sada A. Harbarger, Ohio State, W. K. Hatt, Purdue, E. R. Hedrick, University of California, R. A. Seaton, Dean of Engineering, Kansas State Agricultural College, J. W. Votey, University of Vermont, and S. M. Woodward, State University of Iowa, council. The next convention of the society will be held at the University of Maine, Orono, Maine.

Cement Association Takes Over Research Work

After June 30 the work of the Structure Materials Research Laboratory, which has been carried on by the Portland Cement Association in co-operation with the Lewis Institute at the building of the latter, 1951 West Madison St., Chicago, will move to the new P.C.A. building, 33 W. Grand Ave., Chicago. The work there will be continued as the Research Laboratory of the Portland Cement Association. Duff A. Abrams continues in charge of the laboratory.

Overflow Indicates Silting Up of Pescadero Cut

On June 14 telegraphic dispatches from Calexico stated that about half the flow in the Colorado River was pouring through a 600-ft. break in Pescadero levee which extends to the southwest beyond Pescadero Cut and along its north side. The break was not considered a menace to Imperial Valley lands because the river is now at a comparatively low stage and the Saiz and Volcano Lake levees stand as a second line of defence some distance to the west and north of the overflowing waters.

Significance attaches to the break, however, because it occurs with a flow of only 65,000 or 70,000 sec.ft. while in June, 1922, the year in which the Pescadero Cut was put in service, a flood of 112,000 sec.ft. followed this route without overflow. It is believed that a considerable silting up of this route has occurred, probably just below the Pescadero Cut itself. The present situation has given rise to speculation as to what might occur in a heavy flood. The flood of 1916 amounted to about 240,000 sec.ft.

Moffat Tunnel Commission Sells More Bonds

Unforeseen difficulties existing in boring the Moffat Tunnel have increased the cost beyond the upset price of $6,720,000 laid down by the Colorado Legislature in 1922 when it ordered the tunnel driven. Little preliminary investigation along the line of the tunnel was or could be made in the way of borings on which to base cost estimates. A new 5½ per cent loan of $3,500,000 just negotiated is the second supplemental loan, the first being for $2,500,000. Much of the added cost is chargeable to timbering required by the nature of the work encountered and by other normal developments of the work, but aside from some water flows there have been no serious difficulties. J. Vipond Davies, consulting engineer, states that work is proceeding satisfactorily and conditions encountered are normal.

Progress as of May 15th was reported as follows: Pioneer tunnel, east portal 15,459 ft., west portal 12,413 ft., leaving 4,511 ft. between the headings; main tunnel, east portal 14,868 ft., west portal 12,038 ft. The railroad tunnel has been enlarged to full size 13,239 ft. at the eastern end and 6,760 ft. at the western end.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J.; June 21-25, 1926.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Summer Meeting, Seattle, Wash., July 14-16; Annual Convention, Philadelphia, Pa., October 4-9, 1926.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Providence, R. I., Sept. 14-17 1926.

INTERNATIONAL CITY MANAGERS' ASSOCIATION, Lawrence, Kansas; Annual Convention, Colorado Springs, Colo., Sept. 21-23, 1926.

The Providence (R. I.) Engineering Society at its June 8 meeting elected the following officers: President, Francis B. Marsh; vice-president, R. Leslie Fletcher; secretary, A. W. Meyer; and treasurer, C. T. Morey.

The Council of the Affiliated Technical Societies of Boston held its annual meeting June 7 and elected for the ensuing year the following officers: Chairman, Frederic A. Eustis; vice-chairmen, Lewis E. Moore and Frank A. Marston; and treasurer, Alfred Kellogg.

The San Francisco Section of the American Society of Civil Engineers at its bimonthly meeting on June 15 elected R. A. Monroe secretary-treasurer to succeed Harold B. Hammill. A. Kempkey presented the paper of the evening which described the Gordon Valley project that provides a water supply for the city of Vallejo.

Personal Notes

DR. CHARLES TERZAGHI, during the past year special lecturer on soil mechanics at Massachusetts Institute of Technology, has been appointed associate professor at the Institute.

THORNDIKE SAVILLE, professor of hydraulic and sanitary engineering at the University of North Carolina, has been given a year's leave of absence from the University and from his work for the North Carolina Department of Conservation and Development. Professor Saville, who recently made a brief trip to Venezuela for the International Health Board of the Rockefeller Foundation in company with Dr. H. H. Howard, Director for the West Indies for the Rockefeller International Health Board, has been "loaned" to the government of Venezuela to organize and for the time to administer a Bureau of Sanitary Engineering. The Venezuelan government has control of many municipal affairs, including water supply, sewage, garbage and malaria control. Professor Saville will investigate and plan additional new water supplies for some of the larger cities of Venezuela. He will take with him an assistant engineer from this country, but otherwise his staff will be supplied by the Venezuelan government. He will sail for Venezuela with his family July 3.

A. J. BOZE has been appointed county highway engineer for Adams County, Wisconsin, to succeed John McGregor, resigned.

FRANK BURTON has tendered his resignation as commission of the building department of the city of Detroit, in order to go into private practice in Detroit. Mr. Burton has been building commissioner in Detroit for the past five years; he is also president of the Building Officials Conference.

W. K. SEITZ, lately city engineer of St. Joseph, Missouri, has resigned his former position to become city manager of Melbourne, Florida.

MAJOR GENERAL HARRY TAYLOR, the retiring Chief of Engineers, expects to remain at his desk until the very end of his term. He will turn the office over to Major General Edgar Jadwin, his successor, on June 28, but he will have to remain on duty for several days to dispose of the various matters he has been handling personally. General and Mrs. Taylor will leave shortly for an extended European tour.

THOMAS T. TOWLES, formerly with the Department of Public Works, Richmond, Va., and prior to that with the du Pont Engineering Co., has recently taken a position as engineer in the structural division of Stone & Webster, Inc., Boston, Mass.

MAJOR M. P. FOX of the Corps of Engineers is in Brûssels to attend the Navigation Congress. While in Europe he will visit various navigation works.

H. R. WAKE, of the engineering staff of the Aluminum Company of Canada, has been appointed town manager of Arvida, the new industrial town on the Saguenay River.

A. D. C. BLANCHARD, hydraulic engineer of the New Brunswick Electric Power Commission, has resigned and will join the staff of the International Paper Co., Grand Falls, N. B.

G. S. SMITH has been appointed assistant division engineer of the Colorado division of the Missouri Pacific R.R.

FRANK A. BARBOUR and G. GALE DIXON announce the dissolution of the partnership of Barbour and Dixon, consulting engineers, Boston, Mass. Mr. Barbour will practice in his own name, as prior to the partnership, specializing in hydraulic and sanitary engineering, with offices in the Tremont Building, Boston. Mr. Dixon joins the engineering staff of the Mahoning Valley Sanitary District, at Youngstown, Ohio.

F. M. RANDLETT has been promoted to the position of Pacific Coast Manager of Robert W. Hunt Co. Mr. Randlett was formerly district manager in the Pacific Northwest, with headquarters at Portland, Ore., and Seattle, Wash., and previous to that time was for many years chief engineer of the Water Department of Portland, Ore.; he served previously in the engineering department of the New York, New Haven & Hartford R.R. and with Stone & Webster, Inc.

WILLIAM B. GESTER, who established the San Francisco office of Robert W. Hunt Co. in 1903, continues his association with that company in the capacity of consulting engineer, with headquarters at San Francisco.

J. H. MANNING, vice-president of the division of engineering and construction, Stone & Webster, Inc., Boston, will shortly transfer his headquarters to the New York office of the company at 120 Broadway.

EDWARD E. WALL, formerly director, public utilities, for the city of St. Louis and for many years water commissioner has opened an office as consulting engineer in the Merchants-Laclede Building, St. Louis.

VERNE E. ALDEN, assistant to general superintendent of Consolidated Gas, Electric Light & Power Co., of Baltimore, Md., for the past eight years and prior to that in electrical design work with the Westinghouse Electric & Manufacturing Co. at East Pittsburgh, Pa., has joined the mechanical division of Stone & Webster, Inc., at its Boston office.

C. F. LOWETH, Chicago, Ill., chief engineer of the Chicago, Milwaukee & St. Paul Ry., received the degree of doctor of engineering from Rose Polytechnic Institute, Terre Haute, Ind., June 10.

GEORGE L. ALDEN, head of the mechanical engineering department of Worcester Polytechnic Institute, Worcester, Mass., received from this institute June 18 the degree of doctor of engineering. Professor Alden has been engaged during the past few years in developing the new hydraulic laboratory for Worcester Polytechnic Institute, which was opened recently.

Obituary

CHARLES G. YOUNG, consulting engineer, New York City, former president of the C. G. Young Engineering Co., died suddenly at a place near San Juan, Porto Rico, June 16, after returning from work on an engineering project in Santo Domingo. Mr. Young was born in Bath, N. Y., in 1866, was educated at Haverling Academy, and was engaged for a number of years in electrical engineering work. From 1902 to 1909 he was construction manager for the White-Crosby Co. and the J. G. White Co. Since 1909 he had been president of the company bearing his name, engaged in consulting engineering and construction work, investigations and plans for public utilities, in this country, South America, Europe and Asia.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Concrete Road Yardage

For May the square yardage included in concrete pavement contract awards, according to the Portland Cement Association were: 8,910,678 for roads; 4,619,195 for streets; and 507,250 for alleys; or a total for the month of 14,037,123 sq.yd.

The accompanying table summarizes the statistics for the current year:

SQUARE YARDS OF CONCRETE PAVEMENT AWARDED DURING 1926

Month	Roads	Streets	Alleys	Total All Classes
Jan.....	2,161,415	1,410,201	57,218	3,628,834
Feb.....	2,726,611	2,010,941	274,836	5,012,388
March..	4,662,885	3,050,630	224,879	7,938,394
April...	8,758,195	4,324,729	479,763	13,562,687
May....	8,910,678	4,619,195	507,250	14,037,123
Totals	27,219,784	15,415,696	1,543,946	44,179,426

Relative Wear of Floorings

Experimental work at the Mellon Institute of Industrial Research, Pittsburgh, instituted by tile manufacturers, has resulted in some comparative data on wood and other flooring materials.

Pressure was applied on the different materials by a wheel shod with leather surfaces and fine sand was constantly fed between the leather and floor material to imitate the effect of dirt ordinarily found in some amount on all floors. After a test period of similar duration in each case, the material was weighed to determine the percentage loss by abrasion. Following is a list of the materials tested and the amount of wear under the test:

Material	Average Per Cent Loss
Vitreous tile	4.57
Marble	23.18
Maple wood	23.79
Rubber	20.59
Linoleum	56.57
Oxychloride cement	50.10
Neat Portland cement	16.79
Asphaltic composition	80.11
Cork tile	45.93

It will be noted that vitreous tile resisted wear most effectively. The test conditions were perhaps not entirely representative of actual practice, as mortar of cement and sand, rather than neat Portland cement, is usually employed for floor surfacing, and the wood floors were tested without the protection of varnish or other floor finish, such as is almost invariably applied in practice.

National Training School for Apprentice Tile Setters

Under the auspices of the Associated Tile Manufacturers, a training school for apprentice tile setters is under way at Dunwoody Institute in Minneapolis. A few years ago an experimental course was conducted at Dunwoody by the tile manufacturers but there followed a period during which the progress was slow.

The new school is planned for four courses, the first beginning on June 1. Each course is 13 weeks. The other courses will start in September and December of this year and in March, 1927. There are about 20 apprentices in the course now under way. It is the intention of the school to show that instruction can be given in a way that will shorten the apprenticeship term, turn out good workmen and yet not overcrowd the ranks of the trade.

Business Notes

GENERAL ELECTRIC CO., Schenectady, N. Y., announces that it is aiding in the manufacture of two new oil-electric locomotives that are to be applied to industrial and short line freight service. The Red River Lumber Co. plans to place a 100-ton oil-electric locomotive in service on a line 15 to 20 miles in length. Maximum grades are of 2 to 3 per cent. The Utah Copper Co. will soon place a 60-ton unit in service at Bingham, Utah, for hauling waste cars on the upper levels at its mine. The 100-ton locomotive is similar to those used by the Long Island and Great Northern Railway. The smaller locomotive is like those of the Central Railroad of New Jersey, B. & O., Lehigh Valley, D. L. & W., Reading and the Erie. These oil-electric locomotives are being developed jointly by the American Locomotive Co., Ingersoll-Rand Co. and General Electric Co.

FAIRBANKS STEAM SHOVEL CO., Marion, Ohio, has been purchased by the Osgood Co., of the same city. The purchasers are prepared to furnish from the records and drawings now in their possession repair parts for Fairbanks machinery and equipment that is now in the field. Charles Melvin, who was connected with the Fairbanks Steam Shovel Co. for 24 years, has been retained by the Osgood Co. and placed in charge of the department for handling service and repair parts on Fairbanks machines. All owners of dredges or other Fairbanks equipment are requested to write to the Osgood Co., giving the present location of their machinery.

TIMKEN ROLLER BEARING CO., Canton, Ohio, announces the following changes in its personnel: H. E. Gilmore promoted to manager of the St. Louis branch, following several years' experience at the Chicago branch; G. W. Curtis promoted from industrial equipment engineer to district manager of sales, industrial division, for the Milwaukee territory. S. M. Weckstein succeeds Mr. Curtis as industrial equipment engineer. G. W. Richards and A. R. Spicacci are appointed assistants to Mr. Weckstein.

FREEMAN W. STOWE, formerly sales engineer with the Sivyer Steel Casting Co., Milwaukee, has become associated in the same capacity with Deemer Steel Casting Co., New Castle, Del.

ARMCO CULVERT & FLUME MANUFACTURERS ASSOCIATION is celebrating this year the 30th anniversary of the invention of the corrugated culvert. In the thirty years the original design has remained unchanged. The first corrugated culvert manufactured by the inventor, James H. Watson, was recently removed from under a public highway near Crawfordville, Ind., where it had been placed in 1896. It is now on display at the association's research laboratory at Middletown, Ohio.

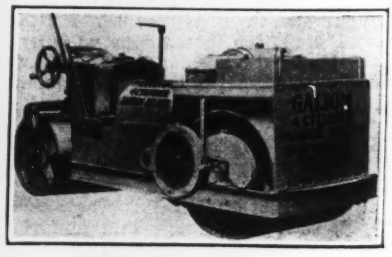
A. W. CLAUSSEN, formerly assistant engineer of the National Underwriters Laboratories, Chicago, has joined the organization of the McWane Cast Iron Pipe Co., Birmingham, Ala., as research engineer, with headquarters in Birmingham.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa., announces that Francis Hodgkinson, for many years chief engineer of the South Philadelphia Works, has been appointed the consulting mechanical engineer for the organization as a whole. At the same time the office of chief engineer has been discontinued, and a new position, manager of engineering, announced. Appointed to the new position is A. D. Hunt, for many years a member of the engineering staff of the company.

Equipment and Materials

Tandem Roller Powered by Gasoline Engine

Embodying several new details in addition to the change from steam to gasoline power, a new tandem road roller manufactured by the Galion Iron Works & Mfg. Co., Galion, Ohio, is available in 5, 6, 7, and 8-ton sizes. A Hercules four-cylinder motor is used, mounted in a rigid chassis frame. The gearing to the driving roll is a simple spur gear arrangement. The roller has two speeds each way, of 2 m.p.h.



and 3½ m.p.h. Gears, shafting and bearings are inclosed in a cast-iron case, while the entire mechanism is inclosed in a sheet metal housing. Both hand and power steering gear are provided, the latter being driven directly from the crank shaft of the engine. Other features are adjustable scrapers on the rolls, phosphor bronze bearings for the axles, and sprinkling, cooling, and gasoline tanks of large capacity.

Sidewalk Protection Bridge Uses Standardized Steel Frame

For protecting sidewalks around buildings under construction or repair, the Patent Scaffolding Co., New York City, has developed a standardized

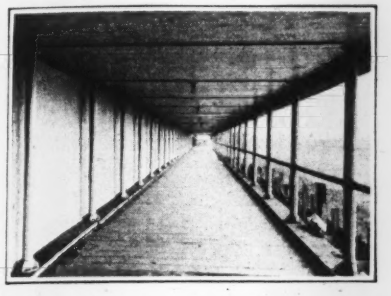


FIG. 1—SIDEWALK BRIDGE AT STEVENS HOTEL, CHICAGO

steel frame sidewalk bridge. The illustrations show the installation around the new Stevens Hotel in Chicago where 1,000 ft. of this sidewalk bridge is being used. The rental value on this job is about $5,000 a month. The bridge may be either purchased outright or rented from the company. It is claimed to be cheaper than wood scaffording, easier to erect, and more pleasing in architectural appearance.

The bridge is suitable for any desired span and the columns may be shifted to miss obstructions, driveways, etc.

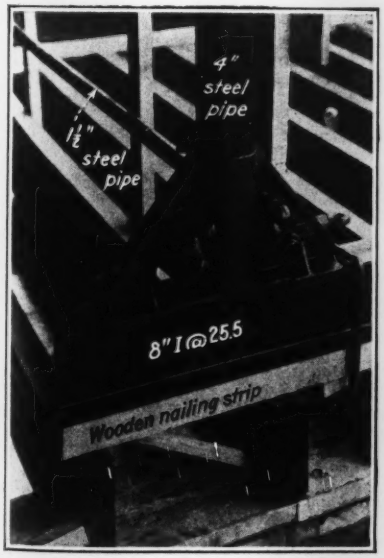


FIG. 2—DETAIL OF COLUMN CONNECTION TO CROSSBEAM

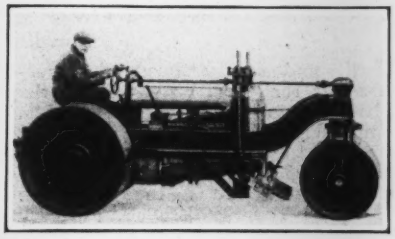
The adjustable span feature is made possible by the clamp connection between the column and the crossbeam. There are no connections that require the drilling of bolt holes.

The unit consists of cross beams of 8-in. I-sections to which are clamped 4-in. steel pipe columns connected in a longitudinal direction by 1½-in. steel pipe. A wooden nailing strip is bolted to the bottom of the cross beam for attaching to the wooden stringers resting on the sill. Wooden panel balustrades are erected between the columns as is usual in all other sidewalk bridges.

New Fordson Roller Convertible Into Three Different Sizes

By means of an arrangement for bolting heavy disks to the wheels, the Wehr Co., Milwaukee, has produced a Fordson road roller which can be made into a three- a four or a five-ton machine. Disks bolted to the rear wheels make it a four-ton roller, and to both the front and rear wheels convert it to a five-ton machine. A feature is that the scarifier has been located ahead of the center of gravity. This means, it is claimed, that the pressure required to force the teeth into the ground does not lessen traction by lifting up on the drive wheels.

The frame is of 8-in. channel steel, and a 3-in. diam. steel shaft is used on the front axle. The equipment is 12 ft.

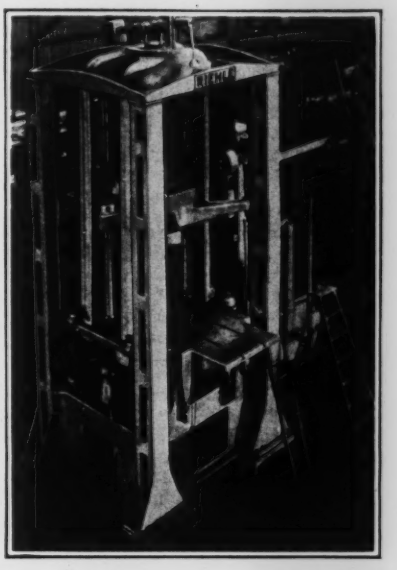


4 in. long, and 5 ft. wide, and has a 9-ft. wheel base. The width of the rear rolls is 16 in., while the diameter of the rear rolls is 42, and the diameter of the front rolls 30 in. There are seven teeth in the scarifier, 4½ in. apart, having a 7-in. ground clearance when raised.

New Line of Vertical-Screw Testing Machines

A patent was granted Feb. 16, 1926, for the new line of testing machines that has recently been introduced by the Riehle Brothers Testing Machine Co., Philadelphia, Pa. The rotating screw feature on the old designs has been retained, so that no part of the machine projects below the base line. This makes a saving in foundation costs, and permits the installation of a testing machine in many locations, where otherwise it would be impossible.

The machine embodies the three pulling-screws feature, with which it is impossible to load the machine so that each of the three screws does not carry its share of the load. A single screw has been placed on the center line of the machine toward the front or weighing-beam, and the other two screws are spread equidistant from the center line at the back of the machine. This arrangement is said to be most convenient for conducting tests, since the operator is in full view of the specimen at all



times, and the other witnesses of the test can make observations from any one of three points.

In all of the newer designs of this machine the space between the pulling screws has been widened so that there is more table room and additional space for the placing of specimens and instruments for making observations. The load is indicated on a micrometer dial-screw beam up to full capacity of the machine without the use of end weights. The poise is propelled either manually or automatically, and an autographic recorder can be used to produce a stress strain curve.

The illustration shows one of this type of testing machines of 1,000,000 lb. capacity in the laboratory of Ohio State University. This machine has an opening between screws of 38½ in. A similar machine is now being constructed for the American Steel Foundries of the same capacity, but having a clear space of 74 in. between the screws.

Publications from the Construction Industry

Steel Cross Ties — CARNEGIE STEEL Co., Pittsburgh, has issued the ninth edition of its booklet on steel cross ties, which is divided into three sections—mine ties, ties for portable tracks, and ties for steam and electric railroads.

Silent Chain Drive—LINK-BELT Co., Chicago, in its book No. 812, shows the use of its silent chain drive for machine tools. Illustrations and examples of its use under many conditions are given, so that this book supplements the company's book No. 125 which contains list prices, methods of figuring drives, and

complete information about the details of the product.

Gears—FOOTE BROS. GEAR & MACHINE CO., Chicago, has issued a 600-page book containing a catalog of its complete line of gears and speed reducers, and much engineering information on the same, besides mathematical tables and other information on mechanical engineering subjects. It is indexed by subjects on each page, and has a complete cross reference index in the back. It comprises in fact a treatise on modern speed reduction units and industrial gearing, and should be a valuable reference book.

Drill Carriages—SULLIVAN MACHINERY CO., in its Bulletin No. 81-L describes its drill carriage which was developed by D. J. O'Rourke, formerly in charge at one of the portals of the Moffatt Tunnel, and now on the company's staff.

Lumber Waste Prevention—NATIONAL LUMBER MANUFACTURERS' ASSOCIATION, in its "National Lumber Handbook" for June, 1926, publishes descriptions of the prize winning devices in its recent waste prevention contest. Text and drawings explain the devices in detail. Conditions for the 1926-1927 contest are also given.

For Brinell Machines—MOREHOUSE MACHINE CO., York, Pa., has issued a pamphlet dated June, 1926, describing its proving ring for calibrating Brinell hardness testing machines. These proving rings developed by the Bureau of Standards have just been put on a commercial basis, this pamphlet announces.

Power Shovels and Cranes—KOEHRING CO., Milwaukee, Wis., has recently issued a 1926 edition of its catalog and specifications on its size No. 1 shovels, cranes and draglines. Extra complete specifications are given together with photographs and descriptions of the most important of the machine details. Dipper dimensions are considered rather more fully than has heretofore been the practice.

Rock Asphalt—ROCK ASPHALT CORP., Cherokee, Ala., in its 16-page booklet on "Good Roads, How They May Be Made To Last," gives a description of Cherokee Rock Asphalt, telling what it is, how it is used and its advantages in the construction of pavements. Illustrations are given of the company's quarry, plant, testing laboratory and still others of the rock asphalt in use on new and repair road work.

Air Compressors—BUHL CO., Chicago, devotes two new bulletins, Nos. 102 and 103, to its stationary and portable air compressors. Photographs and specifications are given for both types.

Wire Rope—BRODERICK & BASCOM ROPE CO., St. Louis, devotes the May issue of its monthly house organ to a special fiftieth anniversary number. The growth of the company is outlined and the 50-year development of wire rope in a number of industries is considered on separate pages.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
June 24, 1926	$19,894,000	$23,717,000	$43,611,000
June 17, 1926	29,497,000	27,896,000	57,393,000
June 25, 1925	24,917,000	30,685,000	55,602,000
Heaviest Week			
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
January 1 to date			
1926	511,956,000	850,525,000	1,362,481,000
1925	498,288,000	640,071,000	1,138,359,000

Railways Use Quarter of U. S. Steel Output in 1925

Less Fuel, Lumber and Cement and More Steel and Ballast Required Than During 1924

Fuel, materials and supplies purchased by the Class I railroads of the United States during the year 1925, amounted to $1,392,000,000, a gain of 3.6 per cent over the year preceding and a drop of 19.9 per cent compared with 1923, according to a report of the Bureau of Railway Economics issued May 31, 1926.

These purchases were made directly by the carriers and not through contractors doing construction, equipment building, or other work for the railways.

Of the total output of the nation, the railroads purchased during 1925, the following percentages: bituminous coal, 28 per cent; fuel oil, 20 per cent; forest products, 20 per cent; steel, 25 per cent.

Fuel purchases in 1925 were 2.6 per cent below those of the previous year, yet owing to improved locomotives and other factors, the carriers hauled 6 per cent more freight during the period, as measured in net-ton miles.

Iron and steel requirement for 1925 amounted to $419,254,603, of which $97,728,989 was for rails and $321,525,614 for other iron and steel products. Total steel expenditures increased 15 per cent compared with the year preceding and were 9.8 per cent under 1923. Rail purchases alone were $18,000,000 in excess of 1924 requirements.

Forest products cost the railroads $170,305,031 in 1925, a decrease of 5.8 per cent compared with the preceding year and 26.8 per cent under 1923.

Fewer switching, bridge and cross ties were used in 1925 than in 1924, owing, it is claimed, to increased use of creosoting and other preservative methods. The total timber and lumber footage purchased, however, increased 9.2 per cent during the year.

The carriers required a smaller amount of cement but over 50 per cent more ballast comparing 1925 with the year preceding.

This Week's Special Tabulation of Unit Prices

7. Concrete Masonry

The following unit prices on concrete (1 : 2 : 4) in place are included in the low bidders' estimates on various subway jobs, 1922 to date:

Location	Date	Cu. Yd.	Price per Cu. Yd.
Flushing, N. Y.	Oct. 1922	24,560	$14.75
Brooklyn, N. Y., Bushwick Ave.	Dec. 1922	7,630	15.00
Rochester, N. Y.	May 1923	4,000	21.00
Philadelphia, Pa., Broad St.	July 1923	10,000	15.75
Brooklyn, N. Y., Fourth Ave.	Oct. 1923	20,000	15.80
Brooklyn, N. Y., Sect. 2, R. 70	Apr. 1924	32,660	16.00
Brooklyn, N. Y., Sect. 6-C, R. 8	Oct. 1924	28,050	18.00
Philadelphia, Pa., Broad St.	Oct. 1924	73,000	22.00
New York, N. Y., Sect. 3-A, R. 78	Jan. 1925	29,000	20.00
New York, N. Y., Sect. 2, R. 78	June 1925	29,000	20.00
New York, N. Y., Sect. 6, R. 78	July 1925	47,000	23.00
Philadelphia, Pa., Broad St.	Aug. 1925	63,200	20.00
New York, N. Y., Sect. 1, R. 5	Sept. 1925	21,730	21.00
New York, N. Y., Sect. 4, R. 102	Oct. 1925	29,000	22.20
New York, N. Y., Sect. 3, R. 102	Dec. 1925	27,000	23.00
New York, N. Y., Sect. 2, R. 102	Dec. 1925	23,000	24.00
Sect. 8, R. 78	Mar. 1926	24,450	22.00
Sect. 5, R. 102	Mar. 1926	33,100	22.00

May Borrowings For State and Municipal Improvements 30 Per Cent Under Same Month Last Year

BONDS marketed during May totaled $132,339,182 compared with $109,046,923 of the preceding month and $190,585,636 of May, 1925, according to the *Commercial and Financial Chronicle*. The figures for May, 1925, include the $60,000,000 New York City bonds.

The placings for May, 1926, were augmented by the Detroit, Mich., awards of $22,088,000 and the $18,822,000 bonds of Baltimore, Md., both for general improvement.

Several of the other large issues follow:

$10,082,000 4½s of Westchester Co., N. Y.; $5,000,000 4½s of Chicago Sanitary District, Ill.; $4,395,000 4s of Boston, Mass.; $4,096,000 4½s of Jersey City, N. J.; $3,351,000 4½s of the State of Georgia, and the $3,500,000 5½s of the Moffat Tunnel Improvement District, Colo.

In the accompanying table, the rates ranged from 4 to 6 per cent. Most of the placements called for a premium while a few awards went at par or below.

REPRESENTATIVE PUBLIC BOND SALES, MAY, 1925

State	Purpose	Amount	Rate per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Alabama	Harbor improvement	$1,000,000	4½	101.11	4.19	May 1	1937-43	H. S. Boone & Co. and others, San Francisco
County								
Atlantic, N. J.	Bridge	297,000	4	102.26	4.31	Apr. 1	1928-57	Hoffman & Co., N. Y. City
Alleghany, Va.	Roads	150,000	5	102.58	4.42	July 1	1931	Stranahan, Harris & Oatis, Inc., of Toledo
Aiken, S. C.	Roads	530,000	4¾	100.81	4.57	July 1	1927-33	Eldredge & Co. of New York
Alameda, Calif.	Hospital	600,000	5	107.60	4.27	May 1	1937-43	American Securities Co. and others, San Francisco
Cass, Mich.	Roads	16,425	6	103.12	5.39	May 1	1928-36	Cass Co. State Bk. of Cassopolis
Caroline, Md.	Roads	21,000	4½	101.757	4.24	June 1	1931-37	Robert Garrett & Sons of Baltimore
Delaware, O.	Roads	25,880	5	102.22	4.46	May 3	1927-35	Prudden & Co. of Toledo
Essex, N. J.	Park	491,000	4½	101.93	4.12	May 1	1927-51	J. S. Rippel & Co. of Newark
Fleming, Ky.	Roads	100,000	4½	100	4½	.....	.....	Fant & Co., Flemingsburg, and others
Guernsey, O.	Roads	22,657	5½	104.13	.....	.....	.....	The Herrick Co. of Cleveland
Green, Tenn.	Roads	15,000	6	103.50	.....	.....	1929-31	First Nat. Bk. of Greenville
Garfield, O.	Roads	150,000	5	104.95	4.49	July 1	1939	Stern Bros. & Co. of Kansas City
Hancock, O.	Road improvement	46,750	5	102.48	4.49	Oct. 1	1927-35	W. L. Slayton & Co., Toledo
Hoke, N. C.	Roads	20,000	5	103.44	4.73	May 1	1936-55	Provident Savings Bk. & Trust Co., Cincinnati
Harney, Ore.	Roads	100,000	5½	101.85	5.07	May 1	1936-45	Blyth, Witter & Co. of Portland
Henry, Ind.	Drainage	1,596	6	100.31	5.90	Feb. 15	1927-36	Henry Co. Bk. of New Castle
Hamilton, O.	Road	229,017	4½	100.709	4.35	Apr. 1	1927-36	Harris, Forbes & Co. of Chicago and others
Hillsborough, Fla.	Highway	116,000	5	100.10	4.98	June 1	1928-36	Stranahan, Harris & Oatis, Inc., of Toledo
Houston, Ga.	Roads	160,000	5	.....	.....	Apr. 1	1939-56	The Robinson-Humphrey Co. of Atlanta
Johnston, N. C.	Road and bridge	130,000	4½	101.45	.....	.....	.....	C. W. McNear & Co. of Chicago
Jackson, O.	Roads	32,100	5	100.20	4.95	May 7	1927-35	W. K. Terry & Co. of Toledo
Linn, Iowa	Roads	900,000	4½	100.01	4.24	Nov. 1	1926-41	William R. Compton Co. and others, Chicago
Leflore, Miss.	Jail	125,000	4½	101.78	.....	May 3	25 yrs.	Howe, Snow & Bertles, Inc., of Chicago
	Bridge	65,000	4½	101.78	.....	May 3	25 yrs.	
Lehigh, Pa.	Improvement	800,000	4½	101.073	3.89	June 1	1931-46	Harris, Forbes & Co. of New York
Muskingum, O.	Road	49,202	5½	105.81	.....	Apr. 26	1-10 yrs.	Otis & Co. of Cleveland
Polk, Iowa	Road	225,000	4½	100.07	4.24	May 15	1927-43	White-Phillips Co. of Davenport
Township								
Lower Burrell, Pa.	.....	15,000	4½	100.77	4.45	May 10	1931-55	First Nat. Bk. of New Kensington
East Bethlehem, Pa.	School	80,000	4½	.....	.....	May 1	1933-55	First Nat. Bk. of Fredericktown
Lincoln, Pa.	Road	10,000	5	100.26	.....	May 1	.....	First Nat. Bk. of Sipesville and others
Municip l								
Akron, O.	Street improvement	193,300	5	101.75	4.31	Sept. 1	1927-35	Eldredge & Co. of New York
Alcoa, Tenn.	School	70,000	5	100.66	4.95	May 1	1932-56	W. S. Hill & Co. of Cincinnati
Anacortes, Wash.	Paving	34,000	5	100	5	Apr. 1	1928-42	State of Washington
Athens, N. Y.	Water	160,000	.....	.....	4.40	July 1	1930-64	Redmond & Co. of New York
	Sewer	40,000						
Atlanta, Ga.	Sewer	133,000	5	109.51	4.30	Jan. 1	1929-35	Empire Trust Co. of Atlanta
Beaver Dam, Wis.	Sewer	35,000	4½	102.28	4.26	May 1	1927-46	Old Nat. Bk. of Beaver Dam
Baltimore, Md.	Paving and bridge	4,204,000	4	98.6199	4.11	May 17	1936-53	National City Co. of New York and others
	Conduit	700,000						
	Sewer	5,500,000						
	Office	594,000						
	Museum	505,000						
	Water	2,844,000						
	School	4,475,000						
Beloit, Wis.	Sewer	25,000	4½	101.10	4.29	July 10	1927-39	Beloit Savings Bank
	Street improvement	20,000						
Canton, O.	Improvement	116,914	5	102.40	4.49	Mar. 1	1928-36	Otis & Co. of Toledo
Detroit, Mich.	Improvement	22,088,000	4-4½	.....	3.75-4.20	May 15	1927-56	First Nat. Bank of N. Y. and others
Moorhead, Minn.	Paving	70,000	5	100.03	4.99	June 1	1927-46	Drake-Jones Co. of Minneapolis and others

Steel Output Heavier Than a Year Ago—Demand Slower

Production of steel ingots for the first five months of this year was 7 per cent greater than for the corresponding period in 1925, according to the American Iron and Steel Institute.

The calculated output, all companies, for May, 1926 was 3,945,336 tons as against 4,123,941 in April and 3,454,971 tons during May of last year. The trend in production is very similar to that of 1925, in that both years show a drop in February, a recovery during the month following and a decline from March to the end of May.

Steel Ingot Output—All Companies

	1926 Tons	1925 Tons
January	4,150,469	4,193,281
February	3,801,776	3,752,352
March	4,488,362	4,194,340
April	4,123,941	3,583,676
May	3,945,336	3,454,971
Five months	20,509,884	19,178,620

Sales of fabricated structural steel for the first five months of this year, totaled 1,024,000 tons, according to the Department of Commerce. This represents about 5 per cent of the steel ingot output for the same period. Last year, structural steel sales for the first five months amounted to 1,000,400 tons or 5 per cent of the steel ingot tonnage produced during those months.

Steel demand, as indicated by unfilled orders on books of the U. S. Steel Corporation, shows a downward tendency similar to that in evidence during the first five months of 1925, with the exception that February of last year gained slightly over the month preceding, while the decline has been consistent since Jan. 1, 1926. Decreased shipments during May prevented the drop in unfilled orders from being more abrupt.

Unfilled Orders On Books of U. S. Steel Corp.

Last Day of	1926 Tons	1925 Tons
January	4,882,739	5,037,323
February	4,616,822	5,284,771
March	4,379,935	4,863,564
April	3,867,976	4,446,568
May	3,649,250	4,049,800

Cement Movement Jan. 1 to June 1 Lighter Than in 1925

Cement is following its regular seasonal characteristics as to production, shipments and stocks, but on a larger scale than at this time last year.

A comparison of the cement movement, Jan. 1 to June 1, 1926, with the same period last year, shows a smaller volume of output and demand thus far in 1926. The drop of one per cent in demand has been met by a cut of 5 per cent in output, thus serving to prevent a tendency toward price decline.

The following is according to the Bureau of Mines:

	Production—Bbl.		Shipments—Bbl.	
	1925	1926	1925	1926
Jan.	8,856,000	7,887,000	5,162,000	5,672,000
Feb.	8,255,000	7,731,000	6,015,000	5,820,000
Mar.	11,034,000	10,355,000	10,279,000	9,539,000
Apr.	13,807,000	12,401,000	14,394,000	12,961,000
May	15,503,000	16,467,000	16,735,000	17,950,000
Five Months	57,455,000	54,841,000	52,585,000	51,942,000

Mill stocks, for the entire country, amounted to 21,157,000 bbl., May 31.

Weekly Construction Market

THE recent rise in steel and the comparative steadiness of brick and cement have not served to completely check the downward trend in the construction materials' market. Lumber is weak, with the possible exception of long-leaf yellow pine, but the declining tendencies are marked in materials other than the four just mentioned. Douglas fir timbers dropped $2 per M. ft. at Seattle during the past week. Linseed oil continues to move in an upward direction; prices advanced 2c. in Denver and Chicago and 6c. per 7½-pound gallon at New York, since June 17.

Prices are firm with upward tendencies in steel plates and reinforcing bars. Mill quotations dropped 10c. on blue annealed, 25c. on black and 30c. per 100 lb. on galvanized sheets during the last week. Pittsburgh prices on the principal hot-rolled products are: bars, $2 per 100 lb. in carload lots or better; shapes and plates $1.90 per 100 lb., f.o.b. mill. Pig iron declined $1 per ton at Cincinnati, New York, Chicago and Pittsburgh during the week.

Strikes and other building trades labor troubles are in force in seventeen cities throughout the country. During the last week, hoisting engineers in Kansas City, who had been on strike since May 10, returned to work at the old scale of $1.12½ per hr., with a rate of $1.19 to become effective Sept. 1, 1926. The engineers, together with the carpenters, had demanded $1.25; the latter are being hired back at $1.12½ per hr. in many instances, on an open shop basis, with little disorder reported.

Beginning July 1, Chicago bricklayers will receive $1.62½ per hr., against the old rate of $1.50. Plasterers have already been granted a similar advance.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.40	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$4.00
Structural rivets, 100 lb.	4.50	3.50	4.75	3.50	3.75	4.65	5.00	4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.30	3.38	3.00	3.25	3.77½	3.10	3.25	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	53.6%	55%	54.25%	36%	35.6@49.2%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	51.60@53.60	45.30	54.00	49.20@50.20	53.00	64.00	52.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.10	2.32	2.85	2.31	2.65	1.15
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	1.60	1.65	1.90	1.80	1.50	1.50
Sand, cu.yd.	1.00	1.60	2.00	1.40	1.25	1.00	1.40	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.50	2.83	1.87½	1.75	2.50	1.80	3.00	1.70
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	62.00	34.00	56.00	41.00	39.00@39.75	34.75	27.00	—23.00	55.00
Lime, finishing, hydrated, ton	18.20	23.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.25@2.75	1.50	1.85	2.25	1.60@1.70	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40	10.50	14.10	12.00	—13.75	12.00	15.00	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0895	.112	.075	.076	.075	.....	.09	.12
Hollow partition tile 4x12x12, per block	.1112	.0895	.112	.075	.076	.075	.108	.09	.10
Linseed oil, raw, 5 bbl. lots, gal.	.89¼	+.96¾	1.13	+.94	+.99¾	+1.13	.97	1.12	1.03
Common Labor									
Common labor, union, hour	.90⅝	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.45@.60	.40@.45	.50	.50	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.
Labor—Concrete laborers' rate, 93⅜c.; building laborers, 90⅝c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 3 the next on July 1.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.156). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83.

Business Briefs

Call money quoted at 4½ per cent, June 22; year ago 4½ per cent.

Time loans: Sixty-ninety days, 4½; four-six months, 4¼ per cent.

Commercial paper: Best names 4 per cent; other names, 4¼ per cent.

On June 1, 1926

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For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month